

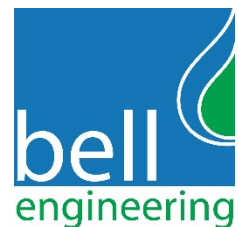
SPECIFICATIONS FOR
CONTRACT 170-18-103

WATER TREATMENT PLANT STANDBY POWER

*RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY*



March 2018



2480 Fortune Drive
Suite 350
Lexington, KY 40509
859/278-5412

107 Forbes Drive
Hopkinsville, KY 42240
270/886-5466

1278 Hendersonville Road
Suite D
Asheville, NC 28803
828/774-5499

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**CONTRACT 170-18-103
WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY**

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SECTION 00010

**ADVERTISEMENT FOR BIDS
CONTRACT 170-18-103
WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY**

Sealed proposals for the following work will be received by the Richmond Utilities Board, Madison County, Kentucky, at the utility board's office at 300 Hallie-Irvine Street, Richmond, Kentucky 40475, until 2:00 p.m., local time, Thursday, April 12, 2018, for furnishing labor and materials and performing all work as set forth by the Advertisement, General Conditions, Specifications and/or Drawings prepared by Bell Engineering. Immediately following the scheduled closing time for the reception of bids, all proposals which have been submitted in accordance with the above conditions will be publicly opened and read aloud.

The work to be bid is described as follows:

CONTRACT 170-18-103

The addition of standby power to the water treatment plant.

Drawings, Specifications and Contract Documents may be examined at the following places:

Richmond Utilities Board
300 Hallie-Irvine Street
Richmond, Kentucky 40475

Bell Engineering
2480 Fortune Drive, Suite 350
Lexington, Kentucky 40509

or may be obtained from Lynn Imaging, 328 E. Vine Street, Lexington, Kentucky 40507, phone: 859/255-1021, upon receipt of non-refundable deposit as follows:

CONTRACT 170-18-103-\$125.00

Sealed proposals for this Contract shall be clearly marked on the outside of the envelope as follows:

"Sealed Proposal for Contract 170-18-103. Not to be opened until 2:00 p.m., local time, Thursday, April 12, 2018."

If forwarded by mail, the sealed envelope containing the proposal must be enclosed in another envelope and mailed to the Richmond Utilities Board, allowing sufficient time for such mailing to reach this address prior to the scheduled closing time for receipt of proposals.

Bids shall be accompanied by a certified check or bid bond made payable to the Richmond Utilities Board, Richmond, Kentucky, in an amount not less than the percent of the base bid indicated in Specification Section 00200, Instructions to Bidders, Bid Security. No bidder may withdraw his bid for a period of 90 days after the date bids are opened. He may, however, withdraw his bid at any time prior to the time and date scheduled for opening of same or any authorized postponement thereof. Any bid received after the time and date specified shall not be considered and will be returned unopened to the bidder.

The OWNER's share will be provided from current funds on hand and/or from revenue bonds.

Work to be performed by contractors involved in this project may be subject to the minimum wage rates established by the U.S. Department of Labor under the provisions of the Davis-Bacon Act.

A federal wage rate determination will be incorporated into the Specifications by an addendum issued prior to the scheduled bidding date, if it is applicable to this Project.

Bidders must comply with the President's Executive Order Nos. 11246 and 11375, which prohibit discrimination in employment regarding race, creed, color, sex or national origin. Where the President's Executive Order No. 11246 is shown, Executive Order No. 11375 also applies.

Bidders must make positive efforts to secure small or minority owned business enterprise participation in this Project.

Bidders must comply with Title VI of the Civil Rights Act of 1964, the Anti-Kickback Act, the Contract Work Hours Standard Act, and the Davis-Bacon Act.

Bidders must certify that they do not and will not maintain or provide for their employees any facilities that are segregated or based on race, color, creed, or national origin.

Bidders must show a certification of prior work under Executive Order 11246 (Equal Employment Opportunity) as amended.

All contractors and subcontractors must comply with 41 CFR 60-4, in regard to affirmative action. This is to insure equal opportunity to females and minorities, and apply the time tables and goals set forth in 41 CFR 60-4.

Neither the United States nor any of its departments, agencies or employees is or will be a party to this Invitation for Bids or any resulting contract.

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The Richmond Utilities Board may consider informal any bid not prepared and submitted in accordance with the provisions of this advertisement and/or the Specifications and may waive any informalities or reject any and all bids.

RICHMOND UTILITIES BOARD

By _____
Scott Althausen, General Manager

Bell Engineering
2480 Fortune Drive
Suite 350
Lexington, Kentucky 40509
Phone: 859/278-5412

END OF SECTION

00010-3

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



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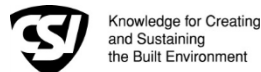
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Construction Specifications Institute



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American Council of Engineering Companies
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American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

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ARTICLE 1 - DEFINED TERMS

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

A. *Issuing Office*--The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered. The issuing office for this Project is Bell Engineering, 2480 Fortune Drive, Suite 350, Lexington, Kentucky 40509.

B. *Administrative Office*—The office from which the bidding procedures are to be administered. The administrative office for this Project is Bell Engineering, 2480 Fortune Drive, Suite 350, Lexington, Kentucky 40509.

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 the Issuing Office. The deposit is non-refundable.

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 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 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 called for below.

A. Refer to Section 00420.

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

4.01 *Subsurface and Physical Conditions*

A. Specification Section 00220, Geotechnical Information, identifies:

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

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

B. Copies of reports and drawings referenced in Paragraph 4.01.A will be made available by the Engineer to any Bidder on request for the non-refundable amount of _____. 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 the Special 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*

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

4.03 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions.

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

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

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

A. examine and carefully study the Bidding Documents, the other related data identified in the Bidding Documents, and any Addenda;

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. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions;

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

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 and in accordance with the other terms and conditions of the Bidding Documents;

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

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

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

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

4.07 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 [_____] [a.m.][p.m.] local time on [_____] at the offices of [_____]. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are required 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 ten 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.

ARTICLE 8 - BID SECURITY

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

8.02 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 annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.

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 Agreement.

ARTICLE 10 - LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, are set forth in 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 with those substitute or “or-equal” materials and equipment presumed to be equal but which will have to be proven equal or acceptable during the shop drawing review phase as described in paragraph 6.05 of the General Conditions. The materials and equipment described in the Bidding Documents establish a standard of required type, function and quality to be met by any proposed substitute or “or-equal” item. The burden of proof of the merit of the proposed item is upon Bidder. Engineer’s decision of approval or disapproval of a proposed item will be final. Bidders shall not rely upon approvals made in any other manner. If, after award of the Contract, the Engineer approves a substitute or an “or-equal” item, and reduction made in contract price will be subtracted from the Bidder’s contract and placed into contingency funds for the Project.

ARTICLE 12 - SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, in which case apparent Successful Bidder shall submit an acceptable substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

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, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General Conditions.

12.03 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 Form is included with the Bidding Documents. Additional copies may be obtained from Engineer.

13.02 All blanks on the Bid Form shall be completed by printing in ink or by typewriter and the Bid signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternative, adjustment unit price item, and unit price item listed therein.

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 Form. 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 Form.

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 covenant to obtain such qualification prior to award of the Contract. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 - BASIS OF BID; COMPARISON OF BIDS

14.01 *Lump Sum*

A. Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents as provided for in the Bid Form. The price for each alternate will be the amount [added to] [or] [deleted from] the base Bid if Owner selects the alternate. In the comparison of Bids, alternates will be applied in the same order as listed in the Bid form.

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

ARTICLE 15 - SUBMITTAL OF BID

15.01 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement or Invitation to Bid and shall be enclosed in an opaque sealed envelope plainly marked with the Project title the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to Richmond Utilities Board, 300 Hallie-Irvine Street, Richmond, Kentucky 40478.

ARTICLE 16 - MODIFICATION AND WITHDRAWAL OF BID

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

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 or Invitation to Bid and read aloud publicly.

17.02 An abstract of the amounts of the base Bids and major alternates, if any, will be made available to all Bidders after the opening of Bids and review of same by 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 Project to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

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 to perform 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 Project.

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.

ARTICLE 21 - SIGNING OF AGREEMENT

21.01 When Owner gives a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement 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 See Specification Section 00700 (00710), Article 6.10, for instructions.

ARTICLE 23 - RETAINAGE

23.01 Provisions concerning retainage are set forth in the Agreement.

SECTION 00220

GEOTECHNICAL INFORMATION

PART 1 GENERAL

1.01 AVAILABLE REPORT

- A. A geotechnical investigation was done during the design of the water treatment plant. This investigation was done by L.E. Gregg. A copy of the report is available for review at the offices of Bell Engineering, 2480 Fortune Drive, Suite 350, Lexington, Kentucky 40509.
- B. The geotechnical report is for bidder and CONTRACTOR information. It is subject to the conditions stated elsewhere in the Specifications, including Instruction to Bidders.
- C. The geotechnical investigation report is not a part of the Contract Documents.

PART 2 PRODUCTS

Not applicable.

PART 3 EXECUTION

Not applicable.

END OF SECTION

BID FORM FOR CONSTRUCTION CONTRACTS

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



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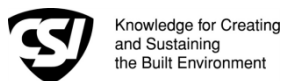
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1015 15th Street N.W., Washington, DC 20005
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American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
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BID FORM

**CONTRACT 170-18-103
WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY**

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ARTICLE 1 – BID RECIPIENT

- 1.01 This Bid is submitted to:

*Richmond Utilities Board
300 Hallie-Irvine Street
Richmond, Kentucky 40475*

- 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 90 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, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged.

<u>Addendum No.</u>	<u>Addendum Date</u>
_____	_____
_____	_____
_____	_____

- 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 federal, state and local 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 in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Special Conditions.
- E. Bidder has obtained and carefully studied (or accepts the consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.
- F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times 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 correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.
- I. 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.
- J. 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.
- K. Bidder will submit written evidence of its authority to do business in the state where the Project is located not later than the date of its execution of the Agreement.

ARTICLE 4 – FURTHER REPRESENTATIONS

4.01 Bidder further represents 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 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 price(s) as shown on the Form of Proposal following Article 9.01 of this Section C-410 of these Specifications.
- 5.02 Unit prices have been computed in accordance with Paragraph 11.03.B of the General Conditions.
- 5.03 Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete within 150 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.B of the General Conditions within 180 calendar days after the date when the Contract Times commence to run.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are attached to and made a condition of this Bid.
 - A. Required Bid security per Specification Section 00200, Instructions to Bidders, Bid Security.
 - B. List of Proposed Subcontractors.

C. List of Proposed Suppliers.

D. Required Bidder Qualification Statement with Supporting Data.

ARTICLE 8 – DEFINED TERMS

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

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____ (SEAL)
(Individual's signature)

Doing business as: _____

A Partnership

Partnership Name: _____ (SEAL)

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

Name (typed or printed): _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

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

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

Name (typed or printed): _____

Title: _____
(CORPORATE SEAL)

Attest: _____
(Signature of Corporate Secretary)

Date of Qualification to do business in _____ [State Where Project is Located] is _____________.

A Joint Venture

Name of Joint Venturer: _____

First Joint Venturer Name: _____ (SEAL)

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

Name (typed or printed): _____

Title: _____

Second Joint Venturer Name: _____ (SEAL)

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

Name (typed or printed): _____

Title: _____

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

Bidder's Business address: _____

Phone: _____ Facsimile: _____

Submitted on _____, 20____.

State Contractor License No. _____. (If applicable)

FORM OF PROPOSAL
CONTRACT 170-18-103
WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY

Note: The following Form of Proposal shall be followed exactly in submitting a proposal for this work. This copy, properly filled in, shall be used in submitting a proposal.

This proposal is submitted by _____

(Name and Address of Bidding Contractor) Zip Code

Date: _____ Phone No.: _____

Area Code

To: Richmond Utilities Board
300 Hallie-Irvine Street
Richmond, Kentucky 40475

Having carefully examined the complete contract documents, including all general and technical specifications and drawings, special requirements, as well as the project site, the undersigned, hereinafter known as the CONTRACTOR, proposes to furnish all labor, materials, tools, machinery, appliances, supplies, equipment, and services as called for by the applicable contract documents, as well as by all Addenda heretofore issued. We agree to enter into a contract and to complete all work required by and under the terms and conditions of the contract documents for the amounts shown in this proposal form.

We acknowledge receipt of the following Addenda:

No. _____, dated _____.	No. _____, dated _____.
No. _____, dated _____.	No. _____, dated _____.
No. _____, dated _____.	No. _____, dated _____.
No. _____, dated _____.	No. _____, dated _____.

If none received, write "none" here: _____.

**CONTRACT 170-18-103 WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY**

SPECIAL INSTRUCTIONS TO BIDDERS

Bidders must bid all divisions for the bid to be responsive. The selection of the low bidder will be based on the low bid of all Divisions. All work specified or shown on the Drawings shall be completed by the CONTRACTOR and all costs associated with a complete, functional project shall be included in the Divisions listed below:

BID PRICE

DIVISION A--WATER TREATMENT PLANT STANDBY POWER

Section 1-Water Treatment Plant Standby Power

The CONTRACTOR shall provide, furnish, and install a new 2,750 kW Genset as specified and/or shown on the Drawings, including, but not limited to, all equipment and appurtenances, excavation, regrade, piping, site work, concrete work, surface preparation, electrical and control work, site demolition, and all other items of work (labor and materials) necessary for a complete and functional facility;

THE LUMP SUM OF _____
_____ DOLLARS AND _____ CENTS (\$_____)

Section 2-Major Equipment Bid Items

The CONTRACTOR shall include in his bid specified on page one above the cost of furnishing and installing the base bid equipment items listed below herein. The CONTRACTOR is encouraged to also list alternate equipment to the maximum extent possible.

Should the Bidder select a manufacturer other than the one used for design or the OWNER selects other Alternate Bid equipment, the Bidder, at no additional cost to the OWNER, shall make any changes to structure, piping controls, electrical, instrumentation, architectural, mechanical, etc. that may be necessary to accommodate this equipment.

Space is provided within the list for Bidders to offer lump sum deductions for alternate equipment not listed under the Base Bid equipment manufacturer. Bidders are not required to offer a deduction for equipment alternate. However, should the Bidder choose to offer, for consideration to the OWNER, any alternate manufacturers/products to those listed, the Bidder shall provide a detailed submittal of applicable items such as catalog cut sheets, pump curves, hydraulic calculations, specifications, wiring diagrams, P&ID's, technical literature, dimensional drawings, etc., or any other information requested by the OWNER. This submittal information shall be included with the Bidder's bidding documents for proper evaluation by the OWNER. These submittal items shall be in addition to the submittal requirements listed in the respective technical specifications section of the equipment item or product hereinafter. Alternates will not be evaluated or pre-qualified prior to Bid opening.

The lowest Bidder will be determined based on the lowest Base Bid Contract Price utilizing the Base Bid Equipment Manufacturer specified herein. Bid Alternate equipment prices will not be used in determining lowest, responsive, and responsible Bidder. After selection of the lowest, responsive, and responsible Bidder the OWNER reserves the right to select any, all or none of the proposed alternates offered by the selected Bidder.

CONTRACT 170-18-103 WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY

Equipment Item	Base Bid Equipment Manufacturer	Alternate Bid Equipment Manufacturer	Lump Sum Deduction
1. Section 16230, Standby Power Generator System	Caterpillar		\$_____
		a. Cummins	\$_____
		b. Kohler	\$_____
		c. Generac	\$_____
2. Section 16496, Bypass/Isolation Automatic Transfer Switch	Russel Electric		\$_____
		a. Eaton	\$_____
		b. Asco	\$_____
		c. Schneider	\$_____
		d.	\$_____
3. Section 08120, Aluminum Flush Doors	Cross Aluminum		\$_____
		a.	\$_____
		b.	\$_____
		c.	\$_____
Subtotal Section 2			\$_____
SUBTOTAL DIVISION A			\$_____
TOTAL BID CONTRACT 170-18-103			\$_____

SECTION 00420

BIDDER'S QUALIFICATION STATEMENT
(TO BE ATTACHED TO THE BID)

1. On Schedule A, attached, list major engineered construction projects completed by this organization in the past five (5) years. (If joint venture list each participant's project separately.)
2. On Schedule B, attached, list current projects under construction by this organization. (If joint venture, list each participant's projects separately.)
3. Name of surety company and name, address, and telephone number of agent.

4. Is your organization a member of a controlled group of corporations as defined in I.R.C. Sect. 1563? ☐ Yes ☐ No

5. Furnish on Schedule C, attached, details of the construction experience of the principal individuals of your organization directly involved in construction operations.

6. Has your organization ever failed to complete any construction contract awarded to it? ☐ Yes ☐ No

If yes, describe circumstances on attachment.

7. Has a Corporate officer, partner, joint venture participant, or proprietor ever failed to complete a construction contract awarded to him or her in their own name or when acting as a principal of another organization? ☐ Yes ☐ No

8. In the last five years, has your organization ever failed to substantially complete a project in a timely manner? ☐ Yes ☐ No

If yes, describe circumstances on attachment.

9. Indicate general types of work performed with your own work force.

10. Furnish the following information with respect to an accredited institution familiar with your organization

Name of Bank _____

Address

Account Manager

Telephone

I hereby certify that the information submitted herewith, including any attachment is true to the best of my knowledge and belief.

By:

Title:

Dated:

SCHEDULE A - PREVIOUS 5 YEARS PROJECTS

<u>Name, Location and Description of Project</u>	<u>Owner</u>	<u>Design Engineer</u>	<u>Date Complete</u>	<u>Contract Price</u>	<u>Reference/Contact Include Address and Phone</u>
--	--------------	------------------------	----------------------	-----------------------	--

SCHEDULE B - CURRENT PROJECTS

<u>Name, Location and Description of Project</u>	<u>Owner</u>	<u>Design Engineer</u>	<u>Date Complete</u>	<u>Contract Price</u>	<u>Reference/Contact Include Address and Phone</u>
--	--------------	------------------------	----------------------	-----------------------	--

SCHEDULE C - PERSONNEL

Name _____	Position _____	Date started with <u>this organization</u>	Date started in <u>construction</u>	Prior positions and <u>experience in construction</u>
------------	----------------	---	--	--

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):

Richmond Utilities Board
300 Hallie-Irvine Street
Richmond, Kentucky 40475

BID

Bid Due Date:

Project (Brief Description Including Location):

Contract 170-18-103

Water Treatment Standby Power

Richmond Utilities Board

Richmond, Kentucky

BOND

Bond Number:

Date (Not later than Bid due date):

Penal sum

(Words)

(Figures)

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

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature and Title

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

Attest: _____
Signature and Title

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

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

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

3. This obligation shall be null and void if:

- 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
- 3.2. All Bids are rejected by Owner, or
- 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

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

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

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

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

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

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

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

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

FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
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AMERICAN COUNCIL OF ENGINEERING COMPANIES

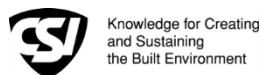
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This document has been approved and endorsed by

The Associated General Contractors of America



Construction Specifications Institute



National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314-2715

American Council of Engineering Companies
1015 15th Street, N.W., Washington, DC 20005

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

**EJCDC
FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR FOR
CONSTRUCTION CONTRACT(STIPULATED PRICE)**

THIS AGREEMENT is by and between _____

(Owner) and _____

(Contractor).

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

Construction of standby power at the water treatment plant.

ARTICLE 2 - THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Contract 170-18-103
Water Treatment Plant Standby Power
Richmond Utilities Board
Richmond, Kentucky

ARTICLE 3 - ENGINEER

3.01 The Project has been designed by

Bell Engineering
2480 Fortune Drive, Suite 350
Lexington, Kentucky 40509

(Engineer), who is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 - CONTRACT TIMES

4.01 Time of the Essence

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

4.02 Days to Achieve Substantial Completion and Final Payment

A. The Work will be substantially completed within 160 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 180 days after the date when the Contract Times commence to run.

4.03 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 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner \$1,000.00 for each day that expires after the time specified in Paragraph 4.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner \$1,000.00 for each day that expires after the time specified in Paragraph 4.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 - CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraph 5.01.A:

ARTICLE 6 - PAYMENT PROCEDURES

6.01 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.

6.02 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 or about the ____ day of each month during performance of the Work as provided in Paragraphs 6.02.A.1 and 6.02.A.2 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:

a. 90 percent of Work completed (with the balance being retainage).

b. 90 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

2. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions.

6.03 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 said Paragraph 14.07.

ARTICLE 7 - INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of 6 percent per annum.

ARTICLE 8 – CONTRACTOR’S REPRESENTATIONS

8.01 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 in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions.

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

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

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

I. 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.

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

ARTICLE 9 - CONTRACT DOCUMENTS

9.01 Contents

A. The Contract Documents consist of the following:

1. This Agreement (pages 1 to ____, inclusive).
2. Performance bond (pages ____ to ____, inclusive).
3. Payment bond (pages ____ to ____, inclusive).
4. Other bonds (pages ____ to ____, inclusive).
 - a. ____ (pages ____ to ____, inclusive).
 - b. ____ (pages ____ to ____, inclusive).
 - c. ____ (pages ____ to ____, inclusive).
5. General Conditions (pages ____ to ____, inclusive).
6. Supplementary Conditions (pages ____ to ____, inclusive).
7. Specifications as listed in the table of contents of the Project Manual.
8. Drawings consisting of ____ sheets with each sheet bearing the following general title: ____ [or] the Drawings listed on attached sheet index.
9. Addenda (numbers ____ to ____, inclusive).
10. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages ____ to ____, inclusive).
 - b. Documentation submitted by Contractor prior to Notice of Award (pages ____ to ____, inclusive).
 - c. ____.
11. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed (pages ____ to ____, inclusive).
 - b. Work Change Directives.
 - c. Change Order(s).

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

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

ARTICLE 10 - MISCELLANEOUS

10.01 Terms

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

10.02 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.

10.03 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.

10.04 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.

10.05 Other Provisions

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

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

OWNER:

RICHMOND UTILITIES BOARD

CONTRACTOR:

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

300 Hallie-Irvine Street

Richmond, Kentucky 40475

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

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

License No.: _____
(Where applicable)

Agent for service or process: _____

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

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):

Richmond Utilities Board
300 Hallie-Irvine Street
Richmond, Kentucky 40475

CONTRACT

Date:

Amount:

Description (Name and Location):

Contract 170-18-103
Water Treatment Plant Backup Power
Richmond Utilities Board
Richmond, Kentucky

BOND

Bond Number:

Date (Not earlier than Contract Date):

Amount:

Modifications to this Bond Form:

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

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____ (Seal)

Name and Title:

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

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____ (Seal)

Name and Title:

SURETY

(Seal)

Surety's Name and Corporate Seal

By:

Signature and Title

(Attach Power of Attorney)

Attest:

Signature and Title

SURETY

(Seal)

Surety's Name and Corporate Seal

By:

Signature and Title

(Attach Power of Attorney)

Attest:

Signature and Title:

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

3. If there is no Owner Default, Surety's obligation under this Bond shall arise after:

3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and

3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and

3.3. Owner has agreed to pay the Balance of the Contract Price to:

1. Surety in accordance with the terms of the Contract;
2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

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

4.1. Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or

4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or

4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
2. Deny liability in whole or in part and notify Owner citing reasons therefor.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of Surety under Paragraph 4; and

6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.

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

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

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

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

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

12. Definitions.

12.1. Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.

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

12.3. Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

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

FOR INFORMATION ONLY – Name, Address and Telephone

Surety Agency or Broker

Owner's Representative (engineer or other party): Bell Engineering, 2480 Fortune Dr., Suite 350, Lexington KY 40509, 859/278-5412

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):

Richmond Utilities Board
300 Hallie-Irvine Street
Richmond, Kentucky 40475

CONTRACT

Date:

Amount:

Description (Name and Location):

Contract 170-18-103
Water Treatment Plant Backup Power
Richmond Utilities Board
Richmond, Kentucky

BOND

Bond Number:

Date (Not earlier than Contract Date):

Amount:

Modifications to this Bond Form:

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

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____ (Seal)

Name and Title:

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

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____ (Seal)

Name and Title:

SURETY

(Seal)

Surety's Name and Corporate Seal

By:

Signature and Title

(Attach Power of Attorney)

Attest:

Signature and Title

SURETY

(Seal)

Surety's Name and Corporate Seal

By:

Signature and Title

(Attach Power of Attorney)

Attest:

Signature and Title:

EJCDC No. C-615 (2002 Edition)

Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, the American Institute of Architects, the American Subcontractors Association, and the Associated Specialty Contractors.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.
2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.
4. Surety shall have no obligation to Claimants under this Bond until:
 - 4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
 - 4.2. Claimants who do not have a direct contract with Contractor:
 1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
 2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
 3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.
5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.
6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:
 - 6.1. Send an answer to that Claimant, with a copy to Owner, within 90 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
 - 6.2. Pay or arrange for payment of any undisputed amounts.
7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.
8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.
9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.
10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.
11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.
13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.
14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.
15. DEFINITIONS
 - 15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
 - 15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
 - 15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone

Surety Agency or Broker:

Owner's Representative (engineer or other party): Bell Engineering, 2480 Fortune Dr., Suite 350, Lexington KY 40509, 859/278-5412

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
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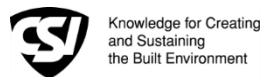
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The Associated General Contractors of America



Construction Specifications Institute

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

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

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

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

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

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

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

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

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

30. *PCBs*--Polychlorinated biphenyls.

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

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

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

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

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

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

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

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

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

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

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

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

43. *Specifications*--That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain

administrative requirements and procedural matters applicable thereto.

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

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

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

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

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

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

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

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

52. *Work Change Directive*--A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times

but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.

B. Intent of Certain Terms or Adjectives

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

C. Day

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

D. Defective

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

- a. does not conform to the Contract Documents, or
- b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or
- c. has been damaged prior to Engineer's - recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. Furnish, Install, Perform, Provide

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

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

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

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

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

ARTICLE 2 - PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

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

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

2.02 Copies of Documents

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

2.03 Commencement of Contract Times; Notice to Proceed

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement

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

2.04 Starting the Work

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

2.05 Before Starting Construction

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

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

2. a preliminary Schedule of Submittals; and

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

2.06 Preconstruction Conference

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

2.07 Initial Acceptance of Schedules

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

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

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

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

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

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

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

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

3.02 *Reference Standards*

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

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

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or

responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

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

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

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

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

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

b. the provisions of any Laws or Regulations applicable to the performance of the Work

(unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

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

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

1. A Field Order;

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

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:

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

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

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

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's

sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

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

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

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

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

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

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

4.02 *Subsurface and Physical Conditions*

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

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

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

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

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

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

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

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

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

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

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

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

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

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

C. Possible Price and Times Adjustments

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

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

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

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

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

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

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

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

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

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

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

- a. reviewing and checking all such information and data,
- b. locating all Underground Facilities shown or indicated in the Contract Documents,
- c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and
- d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated

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

promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

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

4.05 *Reference Points*

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

4.06 *Hazardous Environmental Condition at Site*

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

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

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

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

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

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

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

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

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to

entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

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

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

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

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified

in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

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

5.02 *Licensed Sureties and Insurers*

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

5.03 *Certificates of Insurance*

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

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

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection

from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

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

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

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

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

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

b. by any other person for any other reason;

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

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

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

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

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

3. include completed operations insurance;

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

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

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

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

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

5.05 *Owner's Liability Insurance*

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

5.06 *Property Insurance*

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

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

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

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

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

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

6. include testing and startup; and

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

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

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

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any

deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

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

5.07 *Waiver of Rights*

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

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

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

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

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

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

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

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

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract

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

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

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

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or

received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

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

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

6.03 *Services, Materials, and Equipment*

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

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

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

6.04 *Progress Schedule*

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

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

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

6.05 *Substitutes and "Or-Equals"*

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

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

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

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

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

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

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

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

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

2. Substitute Items

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

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

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

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

1) shall certify that the proposed substitute item will:

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

b) be similar in substance to that specified, and

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

2) will state:

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

b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

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

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

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

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

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

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

E. Engineer's Cost Reimbursement: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract

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

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

6.06 *Concerning Subcontractors, Suppliers, and Others*

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

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

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

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

2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual

or entity except as may otherwise be required by Laws and Regulations.

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

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

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

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

6.07 *Patent Fees and Royalties*

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

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

6.08 *Permits*

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

6.09 *Laws and Regulations*

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

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

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

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas

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

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

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

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

C. Cleaning: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

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

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

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

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

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Draw-

ings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

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

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

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

1. Shop Drawings

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

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

2. *Samples:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

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

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

C. Submittal Procedures

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

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

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

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

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents

with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review

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

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

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

E. Resubmittal Procedures

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

6.18 Continuing the Work

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or

disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 Contractor's General Warranty and Guarantee

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

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

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

2. normal wear and tear under normal usage.

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

1. observations by Engineer;

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

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

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

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

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

7. any correction of defective Work by Owner.

6.20 Indemnification

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or

arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

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

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

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

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

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal

shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

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

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

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

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

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

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

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

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and

properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

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

7.02 *Coordination*

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

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

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

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

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

7.03 *Legal Relationships*

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

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

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

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *Pay When Due*

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

8.05 *Lands and Easements; Reports and Tests*

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

8.06 *Insurance*

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

8.07 *Change Orders*

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

8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

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

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

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

Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

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

9.03 *Project Representative*

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

9.04 *Authorized Variations in Work*

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

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

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

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

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

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

9.07 *Determinations for Unit Price Work*

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

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

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

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

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

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show

partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

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

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

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall

promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

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

10.02 *Unauthorized Changes in the Work*

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

10.03 *Execution of Change Orders*

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

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

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

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

10.04 *Notification to Surety*

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

10.05 *Claims*

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

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

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

1. deny the Claim in whole or in part,

2. approve the Claim, or

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

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

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

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

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

11.01 *Cost of the Work*

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

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

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

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and

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

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

5. Supplemental costs including the following:

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

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

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

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

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

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have

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

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

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

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

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

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.

C. Contractor's Fee: When all the Work is performed on the basis of cost-plus, Contractor's fee shall

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

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

11.02 Allowances

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

B. Cash Allowances

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

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

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

11.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

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

12.01 *Change of Contract Price*

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

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an

allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

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

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

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

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

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted

by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

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

12.03 *Delays*

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

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

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

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

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

13.01 *Notice of Defects*

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

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

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

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

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

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

3. as otherwise specifically provided in the Contract Documents.

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

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to

be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

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

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

13.04 *Uncovering Work*

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

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

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

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

13.05 *Owner May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

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

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

13.07 *Correction Period*

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

1. repair such defective land or areas; or
2. correct such defective Work; or

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

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

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

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

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

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

13.08 *Acceptance of Defective Work*

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

after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

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

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

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

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

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

14.02 *Progress Payments*

A. Applications for Payments

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

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

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

B. *Review of Applications*

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

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an

experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

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

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

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

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

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

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

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

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due

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

D. Reduction in Payment

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

c. there are other items entitling Owner to a set-off against the amount recommended; or

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

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

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 Contractor's Warranty of Title

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

14.04 Substantial Completion

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

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

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

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

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

14.05 *Partial Utilization*

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

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

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

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

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

14.06 *Final Inspection*

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

14.07 *Final Payment*

A. Application for Payment

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

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

- a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;
- b. consent of the surety, if any, to final payment;
- c. a list of all Claims against Owner that Contractor believes are unsettled; and
- d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

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

satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance

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

C. Payment Becomes Due

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

14.08 Final Completion Delayed

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

14.09 Waiver of Claims

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 Owner May Suspend Work

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

15.02 Owner May Terminate for Cause

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

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

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

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

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

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

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

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

3. complete the Work as Owner may deem expedient.

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

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

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

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

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

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

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

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

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

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

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

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

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

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

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

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

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

17.02 *Computation of Times*

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

17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

SUPPLEMENTARY CONDITIONS

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



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A. These Supplementary Conditions amend or supplement the Standard General Conditions (or Standard General Conditions-Funding Agency) of the Construction Contract and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemental remain in full force and effect.

B. 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.

ARTICLE I – DEFINITIONS AND TERMINOLOGY

1. Section 00700 (00710), following Article 1.01.A.52 (1.01.A.53), add the following paragraph:

53.(54.) Bonds - Bid, performance and Payment Bonds and/or other instruments of security.

2. Section 00700 (00710) – Article 1.01.A.28 (1.01.A.29), change the first sentence to read: “A written notice given by Owner to Contractor (with copy to Engineer) . . .”

3. Section 00700 (00710), following Article 1.01.A.53 (1.01.A.54), add the following paragraph:

54.(55.) Partial Utilization – Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching completion for all the Work.

4. Section 00700 (00710), following Article 1.01.A.54 (1.01.A.55), add the following paragraph:

55.(56.) Special Conditions – Additional instructions to the Bidder/Contractor denoting special construction or other requirements applicable to this Contract.

5. Section 00700 (00710), Article 1.01.A.34 (1.01.A.43), delete this paragraph in its entirety.

6. Section 00700 (00710), Article 1.01.A.42 (1.01.A.43), revise the paragraph to read “Lands or areas indicated in the Contract Documents as being furnished by the Owner upon which the work is to be performed, including fee simple property, rights-of-way, permanent and temporary construction easements, encroachment permits from governmental and private entities, and such other lands furnished by the Owner which are designated for the use of the Contractor in the completion of the Work.”

7. Section 00700 (00710), following Article 1.01.A.55 (1.01.A.56), add the following paragraph:

56.(57.) Written Notice – Any notice to any party of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at his last given address, or delivered in person to said party or his authorized representative on the Work.

ARTICLE 2 – PRELIMINARY MATTERS

1. Section 00700 (00710), Article 2.01.B, revise to read as follows:

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

2. Section 00700 (00710), Article 2.02, revise the paragraph to read as follows:

A. Owner shall furnish to Contractor up to 5 printed or hard copies of the Drawings and Specifications. Additional copies will be furnished upon request at the cost of reproduction.

3. Section 00700 (00710), Article 2.03, replace paragraph A to read as follows:

“The Contract Times will commence to run on the tenth day after the Notice to Proceed is given and executed by the Contractor. The Notice to Proceed may be given at anytime within 90 days after the date of the Bid Opening. In no event will the Contract Times commence to run later than the one-hundredth day after the day of Bid Opening.”

4. Section 00700 (00710), Article 2.03, add paragraph B to read as follows:

B. Should the Notice to Proceed not be issued within 90 days of Bid Opening, the Contractor may withdraw his bid from consideration or negotiate with the Owner for extension of the bid, as may be applicable and agreeable.

5. Section 00700 (00710), Article 2.05, delete paragraph A and replace with the following paragraph A:

A. Preliminary Schedules

The Contractor shall, within 5 days after the Work commences on the Contract or another period of time determined by the Owner/Engineer, prepare and submit to the Owner/Engineer:

1. Three copies of a practicable schedule showing the order in which the Contractor proposes to perform the Work, and the dates on which the Contractor contemplates starting and completing the several salient features of the Work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of Work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Owner/Engineer may withhold approval of progress payments until the Contractor submits the required schedule.

2. The Contractor shall enter the actual progress on the chart at the end of each month during the construction period and upon doing so shall immediately deliver 3 copies of the annotated schedule to the Owner/Engineer.

3. If the Contractor falls behind the progress schedule, the Contractor shall take such steps as may be necessary to improve the progress. Such steps may include increasing the number of shifts, overtime operations, days of work, amount of construction plant, or all of them, and to submit for review any supplementary schedule or schedules in chart form necessary to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the Owner.

4. Failure of the Contractor to prosecute the Work with sufficient diligence to ensure completion within the time specified in the Contract, or failure of the Contractor to take necessary steps to improve the Contractor's progress should it fall behind the Contractor's schedule shall be grounds for the Owner to terminate the Contractor's right to proceed with the Work, or any separate part of it, in accordance with the terms of the Contract.

5. A schedule of Shop Drawing submissions acceptable to the Engineer as providing a workable arrangement for processing the submissions.

6. A schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. The schedule of values must be acceptable to the Engineer as to form and substance.

7. The Contractor shall also submit a schedule of payments that the Contractor anticipates the Contractor will earn during the course of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS, INTENT, AMENDING, REUSE

1. Section 00700 (00710), Article 3.01, delete paragraph A and insert the following paragraph:

A. The contract Documents comprise the entire Agreement between the Owner and the Contractor concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. Section 00700 (00710), Article 3.01.B, at the end of the paragraph, add the following wording:

“When words which have a well-known technical or trade meaning are used to describe the Work, materials or equipment, such words shall be interpreted in accordance with that meaning.”

3. Section 00700 (00710), Article 3.01, add the following paragraph D:

D. In case of conflict between the Drawings and Specifications, the specifications shall govern unless specifically noted to the contrary in the Drawings. Figure dimensions on Drawings shall govern over scale dimensions, and detailed drawings shall govern over General Drawings.”

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

1. Section 00700 (00710), Article 4.01, delete the first sentence of paragraph A and replace it with the following sentence:

A. All land required for this Project is presently owned by the Owner or is under condemnation. The limits of ownership are shown on the Drawings. Easements for pipelines have been obtained by the Owner or are under condemnation. Easement widths are shown on the Drawings.

The remaining wording in the paragraph remains unchanged.

2. Section 00700 (00710), Article 4.01, delete paragraph C and replace with the following paragraph:

C. The Contractor shall provide at his own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.

3. Section 00700 (00710), Article 4.02, paragraph A – Reports and Drawings, delete the words “The Supplementary Conditions” and replace with the words “The Special Conditions and/or Bid Proposal Addendums identify . . .”

4. Section 00700 (00710), Article 4.04, add the following paragraphs:

C. Damages

1. Repair to existing utilities and facilities damaged by the CONTRACTOR'S construction forces shall be considered as a part of the Contract covered only by the prices bid for the new construction. The only exceptions to this provision, wherein extra compensation will be authorized, are:

a. Relocation of an existing facility due to direct conflict with the new pipeline.

b. Relocation (outside of limits of maximum allowable trench widths) of an existing facility presently located within the bounds of maximum allowable trench width, where necessitated for assurance against future damage due to settlement or to permit reasonable access to the new work.

2. Repair to damaged underground utilities, whether reimbursable or otherwise, must meet the requirements of the agency in charge of that particular utility.

3. The intent of this article is to assure compensation to the CONTRACTOR for changes in existing utilities reasonably necessary, and at the same time, to protect the OWNER against excessive damages due to carelessness of the CONTRACTOR'S construction forces.

4. Compensation for extra work covered herein shall be in accordance with other provisions of the General Conditions.

5. Section 00700 (00710), Article 4.05, following paragraph A, add the following paragraph B:

B. The layout of the work shall be the responsibility of the Contractor and shall be subject to checking by the Engineer. The Engineer shall establish base lines and a system of bench levels for the Contractor's use as required. All instruments, stakes, barricades, traffic signs, flags, and other materials necessary, and personnel needed for establishing and marking lines, grades, and structure location during construction, shall be the responsibility of the Contractor.

The Contractor's personnel engaged in the layout work described herein and the aides furnished to the Engineer shall be fully capable of performing the duties set out herein and shall be fully qualified for the work required.

1. Sewer Lines

The Engineer will provide geometric base data for the Contractor's use in locating sewers and facilities in the design location. The locations for vertical control (bench marks) are shown on the Drawings with elevation and description duly noted. Each manhole, pumping station, wetwell or other notable sewage system component shall have the coordinates shown at the individual locations or listed with the General Notes of the Drawings. It shall be the Contractor's responsibility to locate the new facilities in their intended position using survey grade GPS survey equipment. It shall also be the Contractor's responsibility to provide offset hubs at each manhole or such reference points as may be required to maintain the location of each new installation.

Where the Contractor elects to use grade (batter) boards for sewer construction, offset line and grade stakes shall be set and cut sheets prepared before trenching work is started. All stake-out work and cut sheet preparation shall be accomplished by the Contractor, the Engineer being responsible review and checking the finished cut sheets. The Contractor shall provide all material, equipment and labor for all stake-out work. Cut sheets, where required, shall be prepared on forms supplied by the Engineer 9HKB Form 404-4).

The cut sheets shall contain the following minimum information:

- a. Manhole stations
- b. Grade between manholes
- c. Centerline and offset stations
- d. Amount and direction of offset
- e. Centerline elevation
- f. Centerline cut
- g. Offset elevation
- h. Offset cut
- i. Utilities information and depths and/or any other pertinent information

Where the Contractor elects to use grade (batter) boards for sewer construction, offset line shall be set perpendicular to each 25 foot centerline station. Where laser beam equipment is to be used, the offset line shall be as required for the specific type of laser equipment used. In either case, the Contractor shall be required to maintain at least the offsets at manholes until the sewer main has been constructed.

Where paving or curbs and gutters are existing or where line and grade stakes have been established for same, the Contractor shall determine the elevation of and construct the manholes to the height of the adjacent facilities either existing or proposed. Where paving curbs and gutters or stakes are not existing, the Contractor shall construct the manholes to the height determined by the Engineer.

The Contractor shall furnish all materials required for layout by the Contractor's forces. The Contractor shall furnish all labor and equipment for clearing underbrush, weeds, etc., prior to staking of the sewers.

2. Water, Gas and Sewage Force Mains

Trench line stations will be set by the Contractor ahead of trenching. These will be set at least every 100 feet of pipeline and at the locations of all pipeline accessories.

6. Section 00700 (00710), Article 4.06, paragraph A – Remove the words “Supplementary Conditions” and Replace with the words “Special Conditions and/or Bid Proposal Addendums . . .”

ARTICLE 5 – BONDS AND INSURANCE

1. Section 00700 (00710), Article 5.01, paragraph C – Change the notification time from 20 days to 5 days.

2. Section 00700 (00710), Article 5.03 – Delete paragraph B.

3. Section 00700 (00710), Article 5.03 - Add the following new paragraphs immediately after Paragraph 5.03.A:

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

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

4. Section 00700 (00710), Article 5.04 - 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: \$500,000

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

- a. General Aggregate \$2,000,000
- b. Products - Completed Operations Aggregate \$2,000,000
- c. Personal and Advertising Injury \$1,000,000
- d. Each Occurrence (Bodily Injury and Property Damage) \$1,000,000

e. Property Damage liability insurance will provide Explosion, Collapse, and Under-ground coverages where applicable.

f. Excess or Umbrella Liability

- 1) General Aggregate \$2,000,000
- 2) Each Occurrence \$2,000,000

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:

- a. Bodily Injury:
 - Each Person \$1,000,000
 - Each Accident \$1,000,000
- b. Property Damage:
 - Each Accident \$1,000,000
 - Annual Aggregate \$1,000,000
- c. Combined Single Limit of \$1,000,000

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

- a. Bodily Injury:
 - Each Person \$2,000,000
 - Each Accident \$2,000,000
- b. Property Damage:
 - Each Accident \$2,000,000
 - Annual Aggregate \$2,000,000

5. [Here list additional types and amounts of insurance that may be required by Owner.]

6. Other persons or entities to be included on policy as additional insureds:

- a. Owner: Richmond Utilities Board
300 Hallie-Irvine Street
Richmond KY 40475
- b. Engineer: Bell Engineering
2480 Fortune Drive, Suite 350
Lexington KY 40509
- c. _____

7. Acceptable additional insureds form is CG20 37 07 04—Completed Operations.

5. 5.06.A. 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.

1. This insurance shall:

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

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

1) Other persons or entities to be included on policy as additional insureds:

- (a) Owner:
Richmond Utilities Board
300 Hallie-Irvine Street
Richmond KY 40475
- (b) Engineer:
Bell Engineering
2480 Fortune Drive
Suite 350
Lexington KY 40509
- (c) _____

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

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

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

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

g. include testing and startup; and

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

2. Contractor shall be responsible for any deductible or self-insured retention.

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

6. Section 00700 (00710), Article 5.06, following paragraph A.6 – Add the following paragraphs 4 and 5:

4. Where work involves railroad rights-of-way, the Contractor shall purchase and maintain at the Contractor's expense for the full Contract Period or as required, Railroad Protective Insurance in an amount acceptable to the railroad company.

5. On Federally funded projects, the Contractor shall purchase and maintain at the Contractor's expense for the full Contract Period or as required, flood insurance where the project is in a designated flood hazard area in which Federal flood insurance is available.

7. Section 00700, Article 5.06.B, first word of first sentence, change "Owner" to "Contractor."

8. Section 00700, Article 5.06.E, delete this paragraph.

9. Section 00700, Article 5.08, delete this paragraph.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

1. Section 00700 (00710), Article 6.01, following paragraph B, add a new paragraph C as follows:

C. The Contractor shall at all times be responsible for the conduct and discipline of his employees and/or any Subcontractor or persons employed by the Subcontractor. All workmen must have sufficient knowledge and skill and experience to perform properly the work assigned to them. Any superintendent, foreman or workman employed by the Contractor or Subcontractor who does not perform his work in a skillful manner or acts in an incompetent, disorderly or intemperate manner shall, at the written request of the Owner, be discharged immediately.

2. Section 00700 (00710), Article 6.03, following paragraph C, add the following paragraphs D, E, F and G:

D. Any equipment damaged or which has been subjected to possible damage by reason of inundation, improper storage and/or protection during the construction period of a project, shall be handled only as follows:

Be replaced with new equipment.

With approval of the Engineer, be returned to the manufacturer of the equipment, or his authorized repair agency, for inspection and repair provided; however, that such repair after inspection will place the equipment in new condition, and restore the manufacturer's guarantee the same as for new equipment.

This is particularly applicable to, but not limited to, electric motors, motor controls, meter and gauges, and equipment with bearings.

E. Materials, supplies and equipment shall be in accordance with samples submitted by the Contractor and accepted by the Engineer.

F. Materials, supplies or equipment to be incorporated into the Work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

G. The use of second hand and/or salvaged materials will not be permitted unless specifically provided for in the detailed Specifications. Materials and equipment shall be new when turned over to the Owner.

All materials and/or equipment to be removed from existing structures and not specifically specified to be re-used shall remain the property of the Owner. Such materials and/or equipment shall be stored by the Contractor on sites as directed by the Owner.

3. Section 00700 (00710), Article 6.17.A.1.a, revise the paragraph to read:

a. Submit six (6) copies of each shop drawing required. Upon review and acceptance of shop drawing of material or equipment submitted, two (2) copies will be returned to Contractor noting approval or approval with notations.

4. Section 00700 (00710), Article 6.17.A.2.a, revise paragraph to read:

a. Submit six (6) units of each sample required.

5. Section 00700 (00710), Article 6.17.B, add the following to the existing paragraph:

No portion of the work requiring a shop drawing, working drawing, sample, or catalog data shall be started nor shall any materials be fabricated or installed prior to the review or qualified review of such item. The Owner will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

6. Section 00700 (00710), Article 6.17.C, add the following to paragraph 2:

The certification statement shall include the following information: contract name, contract number, submittal number, contractor's name, contractor's signature (original, not initialed), date, and reference to meeting the obligations required under 00700 (00710), Article 6.17.C.

7. Section 00700 (00710), Article 6.17.C, add the following paragraphs:

4. Shop drawing submittals shall contain:

a. The date of submission and the dates of any previous submissions.

b. The project title, contract number, and submittal number.

c. CONTRACTOR identification.

d. The names of:

- (1) CONTRACTOR
- (2) Supplier
- (3) Manufacturer

e. Identification of the product, with the Specification section number.

f. Field dimensions, clearly identified as such.

g. Relation to adjacent or critical features of the work or material.

h. Applicable standards, such as ASTM or Federal Specification numbers.

i. Identification of deviations from Contract Documents.

j. Identification of revisions on resubmittals.

k. An 8-inch x 3-inch blank space for CONTRACTOR'S and ENGINEER'S stamps.

l. Critical path notation as required.

5. Coordination of Submittal Times

a. The CONTRACTOR shall prepare and transmit each submittal sufficiently in advance of performing the related Work or other applicable activities, or within the time specified in the individual Work section of the Specifications, so that the installation will not be delayed by processing times, including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities.

8. Section 00700 (00710), Article 6.17.E, add the following paragraph:

2. The Contractor shall bear the cost for review and processing of shop drawings after the second resubmittal.

ARTICLE 7 – OTHER WORK AT THE SITE

Revisions not required.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

Revisions not required.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

1. Section 00700 (00710), following Article 9.01.A, add a new paragraph B as follows:

B. Limit of Liability of Public Officials and Owner's Agents.

In carrying out any of the provisions of the Contract or in exercising any power or authority to him thereby, there shall be no personal liability upon the engineer or the Owner's other authorized assistants or employees, it being understood that in such matters they act as the agents and representatives of the Owner.

2. Section 00700 (00710), following Article 9.03.A, add a new paragraph B:

B. Resident Project Representative

The Resident Project Representative assigned to the construction project is a representative of the Engineer whose function is to assist the 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 Resident Project Representative, the Engineer shall endeavor to provide further protection for the Owner against defects and deficiencies in the Work; but, the furnishing of such services will not make the Engineer responsible for or give the Engineer control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs, or responsibility for the Contractor's failure to perform the Work in accordance with the Contract Documents.

The Resident Project Representative is the Engineer's agent at the site, will act as directed by and under the supervision of the Engineer, and will confer with the Engineer regarding the Resident Project Representative's actions. The Resident Project Representative's dealings in matters pertaining to the on-site work shall in general be with the Engineer and the Contractor keeping the Owner advised as necessary. The Resident Project Representative's dealings with Subcontractors shall only be through or with the full knowledge and approval of the Contractor. The Resident Project Representative shall generally communicate with the Owner with the knowledge of and under the direction of the Engineer.

The duties and responsibilities of the Resident Project Representative are limited to those of the Engineer as described in the Engineer's agreement with the Owner and in the construction Contract Documents, and are further limited and described as follows:

Conduct on-site observations of the Work in progress to assist the Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

Report to the Engineer whenever the Resident Project Representative believes that any Work is unsatisfactory, faulty or defective or does not conform to 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 the Engineer of Work that the Resident Project Representative believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by the Engineer.

Shall not advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.

Shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.

The Resident Project Representative shall receive a copy of all correspondence from the Contractor, and shall be kept fully informed of all the Contractor's transactions with the Engineer, including status of submittal and review of Shop Drawings.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

Revisions not required.

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

1. Section 00700 (00710), Article 11.01, at the end of paragraph 11.01.A.5.c, add the following wording:

Equipment rental charges by the Contractor for rented equipment units used on "Extra Work" or "Changes in Work" as may be ordered and authorized by the Owner shall not exceed those charges listed in the latest edition of the "Green Book," compiled and distributed by Associated Equipment Distributors, 615 West 22nd Street, Oak Brook, Illinois 60523.

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

Revisions not required.

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

Revisions not required.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

Revisions not required.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

Revisions not required.

ARTICLE 16 – DISPUTE RESOLUTION

Revisions not required.

ARTICLE 17 – MISCELLANEOUS

1. Section 00700 (00710), following Article 17.06, add a new Article 17.07, titled "Assignments":

17.07 Assignments

1. Neither the Contractor nor the Owner shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest herein, or his obligations thereunder, without written consent of the other party.

2. Section 00700 (00710), following Article 17.07, add a new Article 17.08, titled "Ownership of Plans and Models":

17.08 Ownership of Plans and Models

All Drawings, Specifications and copies thereof furnished by the Engineer are the property of the Engineer. They are not to be used on other work and, with the exception of the signed contract set, are to be returned to the Engineer upon request at the completion of the work. All models are the property of the Owner.

SECTION 00820

SPECIAL CONDITIONS

1. DESCRIPTION OF THE WORK; DESIGNATION OF OWNER AND ENGINEER

1.1 These Specifications and the accompanying Drawings describe the work to be done and the materials to be furnished for the construction of Contract 170-18-03, Water Treatment Plant Backup Power, Richmond Utilities Board, Madison County, Kentucky.

1.2 All references to the OWNER in these Specifications, Contract Documents and Drawings shall mean the Richmond Utilities Board, Madison County, Kentucky.

1.3 All references to the ENGINEER in these Specifications, Contract Documents and Drawings shall mean Bell Engineering.

2. AVAILABLE FUNDS

2.1 The attention of all Bidders is directed to the fact that funds will be made available for the award of this Contract from local funds.

3. TIME OF COMPLETION

3.1 The time allowed for completion of this Contract is as stated in Article 6.01 of Section 00410, and Article 4.02 of Section 00520 of these Specifications.

3.2 The time allowed for completion shall begin at midnight, local time, 10 calendar days from the date on which the OWNER, or his authorized representative, the ENGINEER, shall instruct the CONTRACTOR in writing to start work. In case of awarding more than one Contract to a CONTRACTOR, periods of construction are not additive, but will run concurrently. The same applies to divisions within a Contract.

4. LIQUIDATED DAMAGES

4.1 It is understood that time is of the essence of this Contract, and that the OWNER will sustain damages, monetary and otherwise, in the event of delay in completion of the work hereby contracted.

4.2 Therefore, if the said CONTRACTOR shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the OWNER, then the CONTRACTOR does hereby agree, as a part consideration for the awarding of this Contract, to pay to the OWNER the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of Contract as hereinafter set forth, for each and every calendar day that the CONTRACTOR shall be in default after the time stipulated in the Contract for completing the work.

4.3 The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of

fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount is agreed to be the amount of damages which the OWNER would sustain and said amount shall be retained from time to time by the OWNER from current periodical estimates.

4.4 Liquidated damages are fixed at the following amounts per calendar day of overrun beyond the date set for completion or authorized extension thereof for each of the Contracts, divisions, sections, or combinations thereof per Article 4.03, Section 00520.

5. METHOD OF BIDDING

5.1 The work under this Contract shall be bid by unit price and/or lump sum as provided for in the Form of Proposal. This Contract shall be bid in full on the form provided.

5.2 The CONTRACTOR must bid all divisions and all listed unit price items and/or lump sums to complete a Contract. The OWNER will not award the work on divisions or sections within a Contract separately. Each Contract shall be bid separately and in full on the Form of Proposal provided.

5.3 In the case of major equipment item bidding, the CONTRACTOR must bid the base bid item.

5.4 The OWNER reserves the right to delete _____ or any combination thereof, in making award of Contract, without invalidating the CONTRACTOR's bid on other divisions.

5.5 The OWNER reserves the right, should financing considerations require or allow, to delete or add physical units to the unit price items bid. However, the monetary value of such deletions or additions shall not exceed 25 percent of the total amount bid for the Contract without specific approval of the CONTRACTOR.

5.6 If deletions or additions are made, comparison of bids will be made on the basis of portions of the Contract to be awarded and not on the total of the base bid made by the CONTRACTOR.

6. VIDEO TAPING

6.1 Continuous video recording of preconstruction surface conditions is required for this Contract. All recording and reproduction must be completed before any construction activity will be allowed. Recording must be performed by persons experienced with this type equipment and must be acceptable to the ENGINEER. Recording equipment used shall utilize standard DVD format discs.

6.2 The video recording shall be supplemented with continuous audio description of the area traversed. Verbal description of problem areas and items of special interest shall be elaborated upon.

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6.3 All locations, streets and/or easements on or in which construction activity will occur shall be recorded for the complete length or boundary of the construction area.

6.4 An index shall be furnished for each DVD coordinating the location of the recorded area with the location of the proposed facilities as shown on the Drawings.

6.5 The CONTRACTOR shall be responsible for providing access to all areas to be recorded. All DVD's shall be viewed by the ENGINEER before any construction is started. The CONTRACTOR shall provide DVD viewing equipment for the duration of the project.

6.6 The cost of preconstruction audio/video recording shall be at no additional cost to the OWNER, the cost being incorporated into the CONTRACTOR's unit price or lump sum bid for the items of work as listed on the Form of Proposal.

6.7 The CONTRACTOR is also urged to document on video any structure within a reasonable distance of his blasting or other work operations for reference and file.

6.8 Digital color print still photographs shall be used to supplement the continuous video recording of preconstruction conditions and/or pertinent construction items.

6.8.1 All photographs shall be compiled and saved onto a standard CD-R or DVD-R format disc.

6.9 Any photographs or audio/video recordings required by governing agencies will be the responsibility of the OWNER.

6.10 The CONTRACTOR shall submit to the ENGINEER a number of copies of these documentation media in accordance with the Contract Documents.

6.10.1 Video recordings on DVD-R format discs shall be submitted in a quantity greater than or equal to 4 copies.

6.10.2 Digital still photographs on DVD-R or CD-R format discs shall be submitted in a quantity greater than or equal to 4 copies.

7. MINIMUM WAGE RATES

7.1 Not applicable to this Project.

8. SALES AND USE TAX

8.1 See Specification Section 00700 (00710), Article 6.10, for instructions.

9. EXCAVATION

9.1 It is to be specifically noted that no separate payment for solid rock excavation will be made under this Contract. All excavation shall be considered unclassified, and payment for same included in the lump sum bid.

10. MAJOR EQUIPMENT ITEMS

10.1 Where major equipment items are listed in the Form of Proposal, there will be one or more named suppliers or brands listed thereunder. There will also be blank lines under each heading on which the bidding CONTRACTOR may name additional brands or manufacturers of the particular equipment item which he considers meeting the Contract Specifications. For purposes of comparing construction bids, one brand or manufacturer will be designated as the base bid. Other brands or manufacturers named or to be named by the bidding CONTRACTOR will be designated as substitute A, B, C, etc. The bidding CONTRACTOR shall state his installed price for each named brand or manufacturer's item of equipment and will use the amount so stated for the base bid item in development of his bid for the total Contract. The installed price of any base bid or substitute bid item shall include the CONTRACTOR'S material costs, labor costs, any other applicable costs and profit, and the cost of any redesign and/or construction costs necessary for fitting in the equipment if such is required for use of a substitute equipment item.

10.2 Only major equipment listed and quoted on the Form of Proposal for which the technical data, performance curves, descriptive material, major dimensions, etc., as required by the detailed Specifications, is submitted, in two copies, with the bid will be considered in the final determination of the equipment to be furnished and installed.

11. SUBMITTAL OF DESCRIPTIONS OF MAJOR ITEMS OF EQUIPMENT

11.1 In order that all suppliers may be considered for major equipment items, they shall, prior to or upon the date for receipt of bids, submit to the ENGINEER 2 copies of descriptive literature and drawings of the equipment they are offering. Such drawings and literature shall be in sufficient detail to establish, without question, what is being offered. Failure of suppliers and/or bidding contractors to conform with these conditions may be cause for rejection of their equipment.

12. PERMISSION TO USE PROPERTY OTHER THAN THAT PROVIDED BY OWNER

12.1 Should the CONTRACTOR desire or elect to use, pass over and/or encroach on private property other than that provided by the OWNER, either by fee simple title or right-of-way for a specific purpose, he shall obtain such rights and permission from the individual property owner at his own expense and risk.

13. TIE-IN TO EXISTING WATER MAINS

13.1 As far as possible, the locations and sizes of existing mains are indicated on the Drawings; however, exact locations, pipe materials and sizes cannot be guaranteed. It shall be the responsibility of the CONTRACTOR to locate and uncover

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existing lines, to which new mains are to be connected, and provide all connecting fittings of the correct size and type for each connection. Payment for the above shall be included in the unit price bid for each item used for the connection as indicated on the Drawings or as specified.

14. EXTRA FILL MATERIAL

14.1 Extra fill material required to complete the finished grading to the line and grade shown on the Drawings shall be obtained by the CONTRACTOR at no extra cost to the OWNER above that included in his lump sum bid.

15. USE OF SPECIALS IN VERTICAL PLANE OPTIONAL

15.1 Where specials (fittings) are shown at change in grade of pipeline, the CONTRACTOR, at his option, may use fittings as shown with blocking, or he may, where possible without exceeding maximum allowable deflection in pipe joints, avoid the use of specials at grade changes, by increasing the trench depth, provided the pipe installed to such extra depth is designed to withstand the extra depth cover and the maximum internal pressure specified. No additional compensation will be given for installing the pipe at an extra depth to avoid the use of fittings and thrust blocking.

16. ACCESS TO THE WORK

16.1 The representatives of the OWNER, the ENGINEER, and any other governmental agency having jurisdiction shall have access to the work wherever it is in preparation or progress, and the CONTRACTOR shall provide proper facilities for such access and inspection.

17. ROCK SOUNDING

17.1 Where the approximate location of solid rock is indicated on the Drawings or where it is indicated that sounding did not reveal solid rock, this information is provided for estimating purposes only. While the information is believed to be reasonably correct, there is no guarantee of accuracy or adequacy in determining the actual quantity of solid rock to be removed, the location of solid rock, or the absence thereof.

18. BLASTING AND PREBLAST SURVEYS

18.1 The CONTRACTOR will be held liable for all damages caused by blasting operations required for the construction of this project. All blasting operations shall be performed in accordance with local municipal ordinances and state laws governing such operations, including the storage of explosives.

18.2 Special precautions are required when blasting near natural gas pipelines. The CONTRACTOR shall notify the OWNER of the gas line at or near the area of blasting prior to beginning the blasting operation. The CONTRACTOR shall, with or without assistance from the gas company, develop emergency procedures, planned in advance of each blast.

18.3 Preblast surveys are required on this project for the protection of all parties concerned. These surveys shall be conducted by independent firms specializing in blasting damage control safety.

18.4 Preblast surveys shall be detailed studies of all commercial, industrial, residential or other structures within the areas subject to damage as a result of the blasting operations. The surveys shall include the exterior and/or interior of the building and other improvements on the property such as concrete, brick or bituminous paved drives, parking areas, sidewalks, retaining walls or pillars subject to damage as a result of blasting operations. In rural areas, the surveys shall also include water sources such as wells, springs and dams for farm ponds.

18.5 Individual reports shall be prepared for each parcel of property surveyed within the given radius of the blasting area. Each report shall indicate the type and location of existing structural damage, or the fact that none exists, shown in detail by sketch supplemented by color photo, audio cassette tape supplemented by color photo or video tape, as the CONTRACTOR may elect. Should the video tape method be provided, a video projector shall be furnished for the project duration.

18.6 Preblast survey reports shall also include recommended blasting methods and techniques to preclude damage.

19.7 One copy of each individual report shall be filed with the OWNER for his file and reference prior to the start of blasting operations.

18.8 The cost for preblast surveys shall be considered incidental to the work and shall be included in the bid price for the work.

END OF SECTION

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK COVERED BY THIS CONTRACT

- A. These Specifications and the accompanying Drawings describe the work to be done and materials to be furnished for the construction of water treatment plant standby power included in Contract 170-18-103.
- B. The standby power system is on the south west side of the existing treatment plant lot.
- C. Major work items in this Contract include:
 - 1. Construction of a standby power system including a diesel generator and fuel tank.
 - 2. Construction of an electrical building to house switchgear and the like in support of the generator.
 - 3. Earthwork needed to create a place for the generator and building.

1.02 WORK SEQUENCE

- A. The new electrical building will have to be constructed first.
- B. The generator shall be constructed after the new electrical building has been constructed and tied into the existing electrical service.

PART 2 MATERIALS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01420

STRUCTURAL SPECIAL INSPECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Special inspections as defined in Section 1704 of The Kentucky Building Code are required. Special inspections apply to all inspections required by the building code and will apply to the building pad and 5'-0" beyond. These inspections will also include any isolated structures. There could be some quality control testing (as required by the specifications) that is outside the special inspection area. The cost for those inspections will be the responsibility of the OWNER.
- B. The Inspection Agency shall conduct inspections under the supervision of a qualified professional engineer licensed in the State of Kentucky (Special Inspector).
- C. Seismic Design Category for the structure is shown in the General Notes section of the structural drawings.
- D. Special inspections are required for the following materials and work:
 - 1. Inspection of Fabricators per Section 1704.2 of the Kentucky Building Code.
 - 2. Steel Construction per Section 1704.3 of the Kentucky Building Code.
 - 3. Concrete Construction per Section 1704.4 of the Kentucky Building Code.
 - 4. Masonry Construction per Section 1704.5 of the Kentucky Building Code.
 - 5. Prepared Fill per Section 1704.7 of the Kentucky Building Code.

1.03 SELECTION AND PAYMENT

- A. The Inspection Agency will be responsible for providing all Structural Special Inspection (including testing as listed herein) – scope of work may not be broken into separate contracts with multiple firms.
- B. The Inspection Agency shall be retained by the Owner.
- C. Special inspections are additional to testing and inspection requirements shown elsewhere in the specifications and on the drawings, which is to be paid for by

the General Contractor and is not part of the Special Inspections. The General Contractor shall also pay for additional structural testing and inspection required for his convenience. Inspection work not part of the Structural Special Inspections may be performed by an Inspection Agency of the Contractor's choosing, unless noted otherwise.

- D. Costs for reinspection and retesting, should discrepancies be found, will be paid for by the Owner, as part of the work by the Special Inspector, except where rework is due to negligence or omission deemed excessive by the Owner.
 - 1. In case of excessive rework, such retesting and reinspection shall be paid for by the General Contractor as an additional service of the Inspection Agency.
 - 2. In case of excessive waste/lost time of the Special Inspector due to inadequate scheduling by the General Contractor, such time shall be paid for by the General Contractor as an additional service of the Inspection Agency.

1.04 QUALITY ASSURANCE

- A. Qualified Certification Authorities: Subject to compliance with Kentucky Building Code Requirements, Qualified Certification Authorities providing certification which may be applicable to Project include:
 - 1. American Concrete Institute (ACI).
 - 2. American Institute of Steel Construction (AISC).
 - 3. American Welding Society (AWS).
 - 4. National Institute of Certified Engineering Technology (NICET).
 - 5. Steel Joist Institute (SJI).
- B. Each inspector performing work on the Project shall be qualified to perform inspections for the particular type of construction or operation requiring special inspection by a Qualified Certification Authority as defined in the Kentucky Building Code. "Qualification" for purposes of this section shall mean a certified professional where certification in that jurisdiction exists. Subject to compliance with Kentucky Building Code requirements, Qualified Certification Authorities providing certification which may be applicable to Project include, but are not limited to, the following:
 - 1. Steel Construction
 - a. Material verifications, bolted connections, visual observation of welds – AWS Level 1.
 - b. Ultrasonic, Radiographic, and Liquid Penetrant and Magnetic Particle weld inspection – AWS Level 2.

- c. Steel frame connection details – Professional Engineer licensed in the State of Kentucky with experience in the design of building structures.
- 2. Concrete Construction
 - a. Use of design mix – ACI Level 2.
 - b. Material verifications, sampling of fresh concrete – NICET Level 1 (concrete).
 - c. Reinforcing inspection – NICET Level 2 (concrete).
- 3. Soils and Rock Bearing Materials
 - a. NICET Level 2 (soils).
- C. Prior to any construction, Inspection Agency shall submit list of personnel who may provide inspection work on project. List shall include the name and certification level (qualification) of each inspector. List shall also include the name and professional engineering registration number of the Special Inspector and the Professional Engineer with experience in the design of building structures.
- D. The Inspection Agency shall carry professional liability insurance for errors and omissions to a minimum limit of \$1,000,000 per occurrence and shall submit certificate of insurance along with the qualifications to the Architect and Engineer.
- E. Special Inspector Qualifications: A professional engineer who is legally authorized to practice in the State of Kentucky and who is experienced in providing testing and inspection services of structure system types similar to this Project in material, design, and extent.

PART 2 EXECUTION

2.01 PROGRESS MEETINGS

- A. The Special Inspector shall attend any pre-construction meetings which may be conducted at the construction site by the Structural Engineer to discuss quality issues.
- B. The Special Inspector shall attend construction progress meetings which will be held at the construction site by the Architect, Engineer, and General Contractor.

2.02 CONTRACTOR'S RESPONSIBILITIES

- A. Provide a complete copy all structural shop drawings to the Structural Testing/Inspection Agency.
- B. Arrange the preconstruction meeting to discuss quality issues.

- C. Notify the Structural Testing/Inspection Agency sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
- D. Cooperate with Structural Testing/Inspection Agency and provide access, including equipment with operator, to work. Access equipment includes, but is not limited to, man lifts, excavation equipment, etc.
- E. Provide samples of materials to be tested in required quantities.
- F. Provide storage space for Structural Testing/Inspection Agency's exclusive use, such as for storing and curing concrete testing samples. If required by Special Inspector, General Contractor shall provide cure box with electricity, water, and blankets for curing concrete specimens.
- G. Provide labor to assist the Structural Testing/Inspection Agency in performing tests/inspections. Labor includes, but is not limited to, construction of masonry prisms, etc.
- H. Neither the observation of the Architect/Structural Engineer in the administration of the contract, nor tests/inspections by the Testing/Inspection Agency, nor approvals by persons other than the Architect/Structural Engineer shall relieve the Contractor from his obligation to perform the work in accordance with the Contract Documents.

2.03 SPECIAL INSPECTOR'S RESPONSIBILITIES

- A. Cooperate with the Contractor and provide timely service.
- B. Notify Contractor of minimum advance notice for each type of inspection/test.
- C. Upon arriving at the construction site, sign in and notify the Contractor of presence.
- D. Select the representative samples that are to be tested/inspected.
- E. Perform tests/inspections as outlined in Contract Documents, the applicable codes, and as directed by the Structural Engineer.
- F. Keep records of all inspections.
- G. Furnish inspection reports to the Architect, Structural Engineer, and General Contractor weekly as construction progresses.
- H. Inform General Contractor and / or Fabricator of all discrepancies immediately for correction.
 - 1. Document in writing correction of discrepancies.
 - 2. Highlight discrepancies within the report.

3. If discrepancies are not corrected, the discrepancies shall be brought to the attention of the Code Official and the Structural Engineer prior to the completion of that phase of the work.
- I. Leave copies of field notes with the Contractor prior to leaving the construction site. Field notes shall include the message given to the Contractor, date, time of message, name of Contractor's representative informed, type and location of work or materials tested/inspected, whether the work or materials complies with Contract Documents and name of the Structural Testing/Inspection Agency's representative.
- J. Immediately notify General Contractor, Architect, and Structural Engineer by separate letter if work yet to be inspected is found on site that is either being covered by other work or was to receive continuous inspection.
- K. Structural Testing/Inspection Agency shall not alter requirements of Contract Documents, approve or reject any portion of the work, or perform duties of the Contractor.
- L. Submit a final report of inspections documenting completion of **all** required Special Inspections and correction of any discrepancies noted in inspections to the Structural Engineer. Final report shall be prepared by, sealed, and signed by the Special Inspector and shall include a complete list of materials and work inspected during the course of the project.
 1. Submit one complete set of all special inspection reports to Structural Engineer of Record with final report of special inspections. Report set shall be bound, divided by construction type, and in chronological order.

2.04 INSPECTION OF FABRICATORS

- A. Inspect the fabrication of structural load-bearing members where such work is being performed on the premises of the Fabricator's shop.
 1. Fabricators shall be exempt from special inspection when a Qualified Certification Authority (as defined in section 1702 of The Kentucky Building Code) has periodically reviewed and approved Fabricator's written procedural and quality control manuals and fabrication practices. Subject to compliance with Kentucky Building Code requirements, Qualified Certification Authorities providing certification which may be applicable to Project include, but are not limited to, the following:
 - a. Structural Steel Fabricators – AISC or AWS certified.
 - b. Steel Joist Fabricators – SJI certified.
 2. Fabricators exempt from special inspection shall submit a certificate of compliance to the structural engineer of record at the completion of fabrication stating that all work was completed in accordance with the approved construction documents.

- B. Verify that the Fabricator maintains and review for completeness Fabricator's detailed fabrication and quality control procedures which provide a basis for control of the workmanship and ability to conform to the approved construction documents and reference standards.
- C. Perform special inspections at Fabricator's shop as outlined in this specification for each type of construction.

2.05 INSPECTION OF STEEL CONSTRUCTION

- A. Provide special inspection of the fabrication of steel structural elements and assemblies in accordance with the *Inspection of Fabricators*.
- B. Verify that certification numbers on bolt, nut, and washer containers correspond to the identification numbers on mill test reports and that manufacturer's symbol and grade markings appear on all bolts and nuts. Also verify that bolts, nuts, and washers are being properly cared for at the site.
- C. Verify that identification markings on structural steel members conform to ASTM standards specified on the approved construction documents.
- D. Verify that identification markings on weld filler materials conform to ASTM standards specified on the approved construction documents. Also verify that weld filler material is being properly cared for.
- E. Test and inspect high-strength bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. Perform periodic inspection of bearing type connections.
 - 2. Perform continuous inspection of slip-critical type connections.
 - 3. Verify that direct-tension indicator gaps comply with ASTM F 959, Table 2.
 - 4. Verify that twist-off-type tension-control assemblies have been properly tightened.
- F. Inspect and test welds during fabrication (where applicable) and erection of structural steel as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Inspect all weld procedures and welders according to the requirements of AWS D1.1-2000.
 - 3. Use non-destructive testing according to AWS D1.1-2000, Section 6.11, on all welds that appear to have excessive inclusions, porosities, cracks, and incomplete penetrations as described by AWS D1.1-2000, or have the questionable weld removed and rewelded.

4. Perform continuous non-destructive testing according to AWS D1.1-2000, Section 6.11, on all complete penetration and/or partial penetration groove welds and on all splices of main members where those splices are required.
 5. Perform continuous inspection according to AWS D1.1-2000, Section 6.9 (visual inspection) on all multi-pass fillet welds and on all single-pass fillet welds larger than 5/16".
 6. Perform periodic inspection according to AWS D1.1-2000, Section 6.9 (visual inspection) on all single-pass fillet welds smaller than 5/16" and on all floor, form, and roof deck welds.
- G. Inspect all steel frame connection details for compliance with approved construction documents and approved steel erection shop drawings.
1. Verify completeness and construction of all bracing, stiffening, and connections.
 2. Verify location, completeness and accuracy of all members.

2.06 INSPECTION OF CONCRETE CONSTRUCTION

- A. Provide special inspection of the fabrication of concrete structural elements and assemblies in accordance with the *Inspection of Fabricators*.
- B. Periodically verify the use of the proper design mix.
- C. Verify use of proper grade and ASTM designation of reinforcing steels.
- D. Perform periodic inspection on placement, spacing, clear cover, number, and splice lap lengths of reinforcing steel.
- E. Monitor concrete quality by means of site and laboratory tests. The Inspection Agency is authorized to reject plastic concrete not conforming to specifications. Immediately inform the Contractor, the Architect and the Structural Engineer of inadequacies in concrete quality. Sampling and testing for quality control during concrete placement shall include the following:
 1. Sampling Fresh Concrete: ASTM C 172.
 - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees Fahrenheit (4 degrees Celsius) and

- below, when 80 degrees Fahrenheit (27 degrees Celsius) and above, and one test for each set of compressive-strength specimens.
- d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
- 2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - 4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
 - 5. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- F. Perform continuous inspection of concrete placement to verify proper application techniques.
 - G. Perform periodic inspection of concrete curing procedures to verify maintenance of specified curing temperature, protection, and techniques.
 - H. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
 - I. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other

characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

2.07 INSPECTION OF MASONRY CONSTRUCTION

- A. At onset of masonry construction and periodically thereafter, verify proportions of site-prepared mortar, construction of mortar joints, and location of reinforcement and connectors.
- B. Perform periodic inspection to verify size and location of structural elements; type, size, and location of anchors, including anchorage to other structural elements, frames, and construction; and specified size, grade, and type of reinforcement.
- C. Prior to each grouting operation, verify cleanliness of grout space, placement of all reinforcement and connectors, including lap splice lengths, and proportions of site-prepared grout.
- D. Perform continuous inspection of grout placement to verify compliance with contract document provisions.
- E. Perform periodic inspection of masonry curing procedures to verify maintenance of specified curing temperature, protection, and techniques.
- F. Sample and test grout compressive strength according to ASTM C 1019 and the following:
 - 1. Compression Test Sample: one set of three standard cube specimens for each compressive-strength test, unless otherwise directed. Mold and store cubes for laboratory-cured test specimens except when field-cured test specimens are required.
 - 2. Compressive-Strength Tests: one sample for each day's grouting; one specimen tested at 7 days, one specimen tested at 28 days, and one specimen retained in reserve for later testing if required.

2.08 INSPECTION OF SOILS

- A. Inspect the existing site soil conditions, fill placement, and load-bearing requirements for compliance with the recommendations of the approved geotechnical investigation report.
 - 1. Where the site is specified to be undercut by the geotechnical investigation report, verify all existing uncontrolled fills have been removed from below applicable foundation elements to the specified depth.
- B. Prior to placement of any engineered fill, determine that the site has been prepared in accordance with the recommendations of the approved geotechnical investigation report.

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- C. During placement and compaction of the engineered fill material, verify that the material being used, maximum lift thickness, and in-place dry density comply with the recommendations of the approved geotechnical report.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SANITARY FACILITIES

- A. The CONTRACTOR shall construct and maintain, in a sanitary condition, sanitary facilities for the CONTRACTOR'S employees and also employees of the Subcontractors. The CONTRACTOR shall, at completion of the Contract Work, properly dispose of these sanitary facilities.

1.02 UTILITIES

- A. The obtaining of all utilities for construction, including power and water, shall be the responsibility of the CONTRACTOR, and he shall bear the cost of all utilities used for construction. Cost of all connections and facilities for use of utilities shall be borne by the CONTRACTOR.

1.03 MAINTENANCE OF SERVICE IN EXISTING UTILITIES

- A. Where the existing utilities, including in-plant process piping and plant water piping, must be disturbed during construction under this Contract, their operation and function shall be maintained by the CONTRACTOR to such a degree that service to customers will be interrupted for minimum time periods only. Such disturbances and any maintenance use of these lines shall constitute no cost to the OWNER. **The OWNER shall be notified of interruptions in sufficient time to prepare for them and shall agree to the hour, date, and duration of them before they are undertaken.**
- B. Should shutdowns in service be in excess of the time of duration agreed upon, and such excessive shutdown time be due to the CONTRACTOR's negligence, faulty Work and/or inability to perform, then and in that event, the CONTRACTOR shall be held liable to the OWNER for any and all damages that may accrue to the OWNER, by reason of such excessive shutdown periods.
- C. Digging through services with trenching machines will not be permitted. Upon damage to utility services, such services shall be repaired immediately and tested to the satisfaction of the ENGINEER. The CONTRACTOR shall notify all utility users of impending interruption of service and shall be responsible for all damage resulting from same. Payment for necessary disconnection and reconnection of utility services shall be included as a part of the CONTRACTOR's bid and no extra compensation will be made for same.
- D. The CONTRACTOR shall at all times maintain on hand an adequate supply of repair materials and tools with which to make repair to damaged water, gas and sewer lines. Should the CONTRACTOR inadvertently damage existing utilities, he shall make immediate repair thereto and in no event shall he leave the site before such repair has been made and proven to be successful.

- E. As far as possible, the locations and sizes of existing mains are indicated on the Drawings; however, exact locations, pipe materials and sizes cannot be guaranteed. It shall be the responsibility of the CONTRACTOR to locate and uncover existing lines, to which new mains are to be connected, and provide all connecting fittings of the correct size and type for each connection. Payment for the above shall be included in the unit price bid for each item used for the connection as indicated on the Drawings or as specified.
- F. Where existing structures and equipment at the treatment plant or station are disturbed during construction under this Contract, their operation and function shall be maintained by the CONTRACTOR to such degree that the treatment process will not be impaired. Such maintenance shall constitute no extra cost to the OWNER.

1.04 PROPERTY PROTECTION

- A. Care is to be exercised by the CONTRACTOR in all phases of construction, to prevent damage and/or injury to the OWNER's and/or other property. Payments for the repair and restoration are limited as set forth in "Conflict With or Damage to Underground Facilities" of the Supplementary General Conditions.
- B. The CONTRACTOR shall avoid unnecessary injury to trees and shall remove only those **authorized** to be removed by written consent of the OWNER. Fences, gates, and terrain damaged or disarranged by the CONTRACTOR's forces shall be immediately restored in their original condition or better.

1.05 CONSTRUCTION WARNING SIGNS

- A. The CONTRACTOR shall provide construction warning signs for each location where he is working in the State highway right-of-way or in City streets. He will further provide flagmen as required and shall abide by all Kentucky Transportation Cabinet, Department of Highways safety rules, including size, type and placement of construction signs. All signs shall be of professional quality.

1.06 RESIDENT PROJECT REPRESENTATIVE OFFICE

- A. The CONTRACTOR shall provide at the beginning of construction and remove at the completion of construction, an office with storage room for the exclusive use of the Resident Project Representative, at least 10 feet by 24 feet with at least 3 windows, inside door and outside door with lock. The storage room shall occupy a space approximately 10 feet by 5 feet within the above dimensions. This office shall be at least 100 feet from the CONTRACTOR'S offices and storage buildings.
- B. The office shall be furnished with a desk, 2 chairs, stool, plan rack, and a built-in sloped plans table at least 10 feet long and 3 feet wide with a drawer 42 inches by 27 inches by 4 inches deep inside dimensions. The office shall be equipped with a 4-drawer steel filing cabinet, printing calculator, telephone, air conditioner of adequate size, 3 electric ceiling lights, a \$150.00 allowance for an all-in-one (combination printer, copier, scanner, and fax) color inkjet printer, and at least 3 electric plug-in duplex receptacles.

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- C. During occupancy, the office shall be supplied with telephone, electric, cable or DSL internet service, and janitor services, and shall be supplied with adequate, safe, dependable heat.
- D. Subject to approval of the ENGINEER, the CONTRACTOR may furnish office space in an existing building or a trailer equal to 35 feet by 8 feet "Field Office Trailer" of the Contractor's Trailer Company, Williamstown, Massachusetts.
- E. At completion of the Contract, this temporary structure and all other temporary structures erected by the CONTRACTOR shall become the property of the CONTRACTOR, and he shall remove them from the site at no expense to the OWNER. The CONTRACTOR shall restore the site to a condition equal to that which existed before placement of the office.

1.07 ACCESS ROADWAYS

- A. The CONTRACTOR shall construct all access roadways needed during construction, and the planned access roadways for the completed project. The CONTRACTOR shall maintain access roadways continuously during the construction period.
- B. The CONTRACTOR shall maintain all existing roadways within the project site which are used for any purpose by his construction operations. The degree and frequency of maintenance shall be adequate to keep existing roadways in a condition at least equal to their condition prior to construction. Road maintenance shall include dust control and grading as necessary.

1.08 RESPONSIBILITY FOR TRENCH SETTLEMENT

- A. The CONTRACTOR shall be responsible for any settlement caused by the construction that occurs within 1 year after the final acceptance of this Contract by the OWNER. Repair of any damage caused by settlement shall meet the approval of the OWNER.

1.09 DAMAGE TO CROPS, LIVESTOCK AND VEGETATION

- A. The CONTRACTOR shall protect crops, livestock and vegetation against damage or injury from construction operations at all times. Crops damaged or equipment access obtained outside of the easements provided shall be the responsibility of the CONTRACTOR. Temporary fences shall be provided at no extra cost to the OWNER wherever necessary to keep livestock away from the construction area. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Damaged limbs shall be trimmed and damaged tree trunks shall be treated with wound dressing.

1.10 WASTE DISPOSAL

- A. The CONTRACTOR shall dispose of waste, including any hazardous waste, off-site in accordance with all applicable laws and regulations.

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1.11 CONTRACTOR'S TRAILERS AND MATERIAL STORAGE

- A. The location of the CONTRACTOR'S and Subcontractors' office and work trailers and parking areas on the project site shall be subject to the OWNER's approval.
- B. The location of the CONTRACTOR's and Subcontractors' material storage yards on the project site shall be subject to the OWNER's approval.

1.12 CONSTRUCTION IDENTIFICATION SIGNS

- A. The CONTRACTOR shall furnish and erect project identification signs if such are required by the funding agency.
- B. The CONTRACTOR shall obtain the OWNER'S permission before erecting any construction signs not specifically required by the Contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01600

SPECIAL PROVISIONS FOR MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 SERVICES OF MANUFACTURERS' REPRESENTATIVE AND OPERATING MANUALS

- A. Bid prices for equipment furnished under this Contract, shall include the cost of written operation and maintenance instructions and the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment, and testing of the equipment and to instruct the OWNER'S operating personnel and the ENGINEER'S representative on operation and maintenance. This supervision and instruction may be divided into two or more time periods as required by the installation program, and shall be scheduled at the convenience of the OWNER.
- B. Unless otherwise specified with the equipment, equipment manufacturers shall provide a minimum of 2 separate repeated training sessions for the OWNER'S staff. Each session shall be at least 2 hours in length, but not more than 4 hours. Manufacturer's agenda and schedule for the training shall be submitted to and approved by the OWNER prior to conducting the training. No training will be scheduled until the equipment has been installed; satisfactorily tested, including manufacturer certified test reports having been submitted to the ENGINEER; and is ready for operation.
- C. The manufacturer's representative shall have complete knowledge of the proper installation, lubrication, operation and maintenance of the equipment provided and shall be capable of instructing the representatives of the OWNER and ENGINEER on proper start-up, shut-down, online operations, lubrication and preventive maintenance of the equipment. Outlines of lesson plans and proposed training schedule shall be submitted to the ENGINEER for review 30 days prior to the desired instructional period. Specific requirements for furnishing the services of manufacturer's representatives are indicated under detailed Specifications. This work may be conducted in conjunction with Inspection and Testing, whenever possible, as provided under Part 3 of EXECUTION of detailed specification. Should difficulties in operation of the equipment arise due to the manufacturer's design or fabrication, additional services shall be provided at no cost to the OWNER.
- D. A certificate from the manufacturer on manufacturer's letterhead stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation. A second certificate from the manufacturer shall be provided that indicates the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted to the ENGINEER. See Section 01810, Systems Startup - Commissioning, for additional requirements.
- E. For equipment furnished under other Divisions, the CONTRACTOR, unless otherwise specified, shall furnish the services of accredited representatives of

the manufacturer only when some evident malfunction or over-heating makes such services necessary.

1.02 INSTALLATION OF EQUIPMENT

- A. Special care shall be taken to ensure proper alignment of all equipment with particular reference to pumps, blowers and electric drives. The units shall be carefully aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been reviewed by the ENGINEER, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations, and after conformation of all alignments, the sole plates shall be finally grouted in place. The CONTRACTOR shall be responsible for the exact alignment of equipment with associated piping, and under no circumstances, will "pipe springing" be allowed.
- B. All wedges, shims, filling pieces, keys, packing, red or white lead grout, or other materials necessary to properly align, level, and secure apparatus in place shall be furnished by the CONTRACTOR. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the CONTRACTOR.

1.03 OVERALL EQUIPMENT OPERATION AND MAINTENANCE MANUAL

- A. Four portable rugged hard drives shall be provided by the CONTRACTOR. The rugged hard drives shall have a minimum capacity of 1 terabyte, have a USB 3 connection, be capable of surviving a fall of at least 6 feet and still operate, be water and dust resistant. The unit shall be as manufactured by LaCie, Silicon Power, Transcend, Buffalo, G-Technology or equal.
- B. All of the equipment provided with an operation and maintenance manual shall have a copy of the manual in PDF format installed on each of the rugged hard drives. The O&M manuals shall be placed in folders by Divisions according to the specifications.
- C. These manuals are in addition to what is specified in article 1.04 below for each piece of equipment's operation and maintenance manual.
- D. Noted below is a partial list of Operation and Maintenance manuals to be provided. This list is to aid the CONTRACTOR in determining if all the O&M manuals have been provided and is not all inclusive.
 - 1. Diesel generator
 - 2. HVAC – including air conditioners, heaters, fans, louvers
 - 3. Electrical/Control/Instrumentation and SCADA systems

1.04 INDIVIDUAL OPERATION AND MAINTENANCE MANUALS

A. A minimum of 6 complete sets of operation and maintenance manuals shall be provided for use by the OWNER and ENGINEER. Three sets shall be bound hard copies and 3 sets shall be electronic copies on discs. In addition to providing instructions on how to operate and maintain the equipment or system, the O&M manual shall include instructions for installation/reinstallation of the equipment or system.

1. The manual for each piece of equipment shall be a separate document with the following specific requirements:

a. Contents:

Table of contents and index

Brief description of each system and components

Starting and stopping procedures

Special operating instructions

Routine maintenance procedures

Manufacturer's printed operating and maintenance instructions, parts list, illustrations, and diagrams. These shall be specific to the material supplied under the Contract, and not a manufacturer general brochure.

One copy of each wiring diagram

One final accepted copy of each shop drawing and the CONTRACTOR'S coordination and layout drawing

List of spare parts, manufacturer's price, and recommended quantity

Manufacturer's name, address, and telephone number. See sample cover page at the end of this section.

Name, address, and telephone number of manufacturer's local representative. See sample cover page at the end of this section.

b. Material:

Loose leaf on 60 pound, punched paper

Holes reinforced with plastic, cloth or metal

Page size, 8-1/2 inch by 11-inch

Diagrams and illustrations, attached foldouts as required

Of original quality, reproducible by dry copy method

Covers: oil, moisture, and wear resistant 9 x 12 size

c. Submittals to the ENGINEER:

- (1) One preliminary copy of manuals, no later than 15 days following final review of the shop drawings for each piece of equipment and 6 final copies of complete manuals prior to Field Tests. No equipment shall be started up and tested without at least the engineer having approved the preliminary O&M manual, and a copy provided to him for the start-up and testing.

1.05 GREASE, OIL AND FUEL

- A. All grease, oil, and fuel required for testing of equipment shall be identified by the equipment supplier and furnished by the CONTRACTOR for the respective equipment. The CONTRACTOR shall furnish the OWNER with a 1 year's supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under this Contract.
- B. All lubricants and fuels shall be properly labeled, using an indelible marker and writing on the lubricant container or drum, specifying the type and brand name of the lubricant supplied. A Master Lubrication list must be submitted by the equipment supplier to the ENGINEER for approval clearly stating which lubricants are to be used in the various pieces of membrane equipment and the quantity supplied for one year's use by each unit. The Master Lubrication list shall be submitted in the following format:

MASTER LUBRICATION SCHEDULE - EXAMPLE
(for format and content example ONLY)

<u>Equipment</u>	<u>Lubricant</u>	<u>Quantity</u> <u>(One Years' Supply)</u>
Blower	50 weight oil, Shell XY2, or equal	6 Quarts per unit
Comminutor Drive	90 weight lubricant, Chevron Products G-66, Shell, or equal	4 Gallons per unit

1.06 TOOLS AND SPARE PARTS

- A. Any special tools which may be necessary for the adjustment, operation, and maintenance of any equipment shall be furnished with the respective equipment. Any lubricating devices or tools shall be provided by the

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CONTRACTOR. The equipment supplier shall provide any special tools needed for their equipment.

- B. All spare parts shall be properly protected for long periods of storage (contained in plastic bags or cardboard containers) and labeled for easy identification without opening. The labels shall be written with an indelible marker or be stamped aluminum tags, in the following example format:

Item: shaft sleeve

No. of units: 1

Re-order No.: ACD2614

Supplier: K&S

Supplied for: Main Aeration Blowers

1.07 MAINTENANCE AND LUBRICATION SCHEDULES

- A. The equipment supplier's attention is directed to the Standard General Conditions and the Supplementary Conditions for all requirements relative to the submission of shop drawings for the mechanical equipment. For all mechanical and electrical equipment furnished, the equipment supplier shall provide a list including the equipment name, and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained. In addition, a maintenance and lubrication schedule for each piece of equipment shall be submitted along with shop drawings. Submission shall be in 6 copies. This schedule shall be in the form indicated below.

TYPICAL MAINTENANCE SCHEDULE
(for format and content example ONLY)

<u>Item</u>	<u>Action</u>	<u>Frequency</u>	<u>Remarks</u>
CLARIFIERS: Equipment	Check removal of scum, washdown, if required; remove any debris, etc.	Daily	
	Dewater, examine structure, scrape and paint all exposed metals, examine scraping shoes.	6 mos.	Scrape and clean walls of suitable repair any damage to scraping shoes.
Sludge Collector Drive Unit	Remove shear pin, clean off rust, grease and replace	6 mos.	
Overflow Weir	Check Serviceability	Daily	

TYPICAL LUBRICATION SCHEDULE
(for format and content example ONLY)

<u>Item</u>	<u>Manufacturer's Recommendations</u>	<u>Type Lubricant</u>	<u>Frequency</u>
Spur and Worm gearing	Check oil level as for oil change	See below; same	Weekly
	Change oil	75-80 NSMP Gem Oil (Winter) 80-90 NSMP Gem Oil (Summer)	6 mos.
	Flush out drives before oil change	Kendall Flushing Oil	Prior to oil change
Gear Motors*	Change oil	Kenoil 053 R&O (Winter) Kenoil 072 R&O (Summer)	2,000 hrs. or 6 mos.

*See manufacturer's instructional manual for initial operation instructions.
(IMPORTANT)

1.08 STORAGE, TRANSPORTATION, HANDLING AND PROTECTION OF EQUIPMENT

A. Scope

1. The equipment supplier shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the work site. In addition, the equipment supplier shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the CONTRACTOR for the satisfactory prosecution and completion of the work.
2. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the equipment supplier at no additional cost to the OWNER prior to being incorporated into the work.
3. Included shall be the storage of all materials and equipment on the construction site in a weather protected structure, such as a shipping container, etc.
4. Equipment shall not be shipped until all pertinent shop drawings are reviewed by the ENGINEER.

B. Transportation

1. Equipment shall not be shipped until all pertinent shop drawings have been reviewed and approved by the ENGINEER.
2. All equipment shall be suitably boxed, crated or otherwise protected during transportation.
3. Where equipment will be installed using existing cranes or hoisting equipment, the CONTRACTOR shall ensure that the weights of the assembled equipment does not exceed the capacity of the cranes or hoisting equipment.
4. Small items and appurtenances such as gauges, valves, switches, instruments and probes which could be damaged during shipment shall be removed from the equipment prior to shipment, packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

C. Handling

1. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during loading/unloading or transportation.

2. Lifting and handling drawings and instructions furnished by the equipment supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.
3. Under no circumstances shall equipment or products such as pipe, structural steel, castings, etc., be thrown or rolled off of trucks onto the ground.
4. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.
5. Non-metallic straps shall be used when handling stainless steel items. Carbon steel items shall not come into contact with stainless steel.
6. Lubricants shall be changed by the CONTRACTOR upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

D. Storage and Protection

1. Storage
 - a. Maintain ample way for foot traffic at all times, except as otherwise approved by the ENGINEER.
 - b. All equipment having moving parts such as gears, electric motors, etc., and/or instruments shall be properly stored until such time as the equipment is to be installed. Storage methods shall be approved by the equipment supplier.
 - c. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
 - d. All equipment shall be stored fully lubricated with oil, grease, etc. unless otherwise instructed by the manufacturer.
 - e. Store products in accordance with equipment supplier's instructions. These instructions shall be followed and a written record and as needed a photographic record kept by the CONTRACTOR.
2. Protection
 - a. Use all means necessary to protect the materials, equipment and products of every system before, during and after installation and to protect the installed work and materials of all other trades.

- b. All materials shall be delivered, stored and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism or other causes.
 - c. Substantially constructed weathertight storage sheds, with raised floors, shall be provided and maintained as may be required to adequately protect those materials and products stored on the site which may require protection from damage by the elements.
 - d. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the CONTRACTOR shall start, under instruction of the supplier, the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
- 3. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel and sheet construction products shall be stored with one end elevated to facilitate drainage.
 - 4. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

E. Inspection of Stored Equipment Prior To Installation

- 1. Prior to acceptance of the equipment, the CONTRACTOR shall have the manufacturer/equipment supplier/manufacturer's representative inspect the equipment and certify in writing that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a written certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the CONTRACTOR'S expense.
- 2. Replacements: In the event of damage, immediately make all repairs and replacements necessary for the approval of the ENGINEER and at no additional cost to the OWNER.
- 3. The OWNER reserves the right to withhold payment for any materials improperly stored and maintained.

1.09 Partial Utilization

- A. During the course of construction partial occupation and utilization of completed portions of the work may be required.
- B. When deemed necessary, the OWNER or the equipment supplier may request use of completed work.
- C. Partial utilization shall be practiced in accordance with the General Conditions.

1.10 Equipment Warranty

- A. **The manufacturer shall provide the OWNER a minimum 1 year warranty on all equipment from the date of substantial completion or 18 months from the date of receipt of goods at the point of destination, whichever occurs earliest, or a warranty of the length as is specified in the specific equipment section of the Specifications,** in accordance with the General Conditions, Section 00700/00710. In the event any warranty extends beyond that stated in this paragraph, those extended warranties shall be extended directly to the OWNER. The CONTRACTOR shall provide a statement of warranty from the manufacturer for each piece of equipment that has a warranty period longer than 12 months or has special operating or records requirements, to obtain warranty repair or replacement services.

1.11 ADJUSTMENTS AND CORRECTIONS OF EQUIPMENT AND APPURTENANCES DURING OPERATION

- A. Some items of functional nature included in this Contract cannot be tested as to performance and quality at the time of completion of their installation. They must wait for necessary testing and proper performance until such functions are possible during later portions of this Contract. Such testing, specified performance and proper instructions to the OWNER's operators (as to their maintenance and operation) is deemed a portion of this Contract, and payment shall be retained by the OWNER for equipment delivered to the site and for Work completed to cover such service. Such service replacements and performance shall take precedence over expiration of the 1 year guarantee period.
- B. The manufacturer shall expedite the completion of such service by all Suppliers and Subcontractors and shall render competent supervision of such service. The manufacturer shall also expedite the replacement of defective and unaccepted parts and equipment. Unnecessary delay in delivery and installation of corrective parts and equipment may constitute damage to the OWNER for which the manufacturer can be held liable.

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1.12 INSTALLING NEW EQUIPMENT IN EXISTING STRUCTURES

- A. Where new equipment is planned and/or specified as being installed in existing structures, the CONTRACTOR shall verify all dimensions and locations of existing facilities prior to ordering the new equipment. Existing anchor bolts shall be used when possible, and new equipment shall be fabricated to conform to the existing dimensions, shapes, and locations as required.

END OF SECTION

EQUIPMENT AND SYSTEMS INSTRUCTION REPORT

PROJECT TITLE: _____ CONTRACT NO. _____

SYSTEM OR EQUIPMENT: _____

CONTRACTOR's NAME: _____ MANUFACTURER's NAME: _____

SPECIFICATION SECTION: _____

NOTE: The CONTRACTOR's Representative must maintain and complete this report during instruction.

PRELIMINARY INFORMATION

1. To be completed by the CONTRACTOR:

A. Proposed dates for instruction period: From _____ To _____

B. Name of Representative Instructor: _____

C. Approximate number of hours of training required: _____

2. To be completed by the OWNER:

A. OWNER's Designated Personnel to receive instruction: (Identify supervisor, if required). Place a checkmark under "Present" for attending personnel.

	Present		Present
1)		6)	
2)		7)	
3)		8)	
4)		9)	
5)		10)	

B. Training Session Location: _____

RECORD INFORMATION (To be Completed after Instruction Session)

Instructor's Signature: _____ Date Instruction Completed: _____

Construction Manager's / Superintendent's Signature: _____

OWNER's Signature: _____

SPECIAL CONSIDERATIONS/NOTES:

CONTRACT 170-18-103
WATER TREATMENT PLANT STANDBY POWER
RICHMOND UTILITIES BOARD
RICHMOND, KENTUCKY
MARCH 2018

PIECE OF EQUIPMENT BEING SUBMITTED
DATE SUBMITTED

GENERAL CONTRACTOR:	NAME ADDRESS – MAIN OFFICE TELEPHONE NUMBER, FAX NUMBER, WEB SITE/EMAIL ADDRESS NAME ADDRESS – SECONDARY OFFICE IF APPLICABLE TELEPHONE NUMBER, FAX NUMBER, WEB SITE/EMAIL ADDRESS
VENDER/REPRESENTATIVE:	NAME ADDRESS TELEPHONE NUMBER, FAX NUMBER, WEB SITE/EMAIL ADDRESS
MANUFACTURER:	NAME ADDRESS TELEPHONE NUMBER, FAX NUMBER, WEB SITE/EMAIL ADDRESS
FOR SERVICE:	NAME ADDRESS TELEPHONE NUMBER, FAX NUMBER, WEB SITE/EMAIL ADDRESS

SECTION 01810

SYSTEMS STARTUP – COMMISSIONING

PART 1 GENERAL

1.01 SCOPE

- A. The work includes, but is not limited to, the equipment supplier providing a field service representative to assist, direct and train the CONTRACTOR and OWNER over the course of the commissioning and startup process. The work includes, but is not limited to, the CONTRACTOR providing all labor and materials required to perform commissioning/start-up services of all equipment and mechanical systems provided by the equipment supplier for a complete, functional and fully operational system. This work includes inspection and testing of all general and sub-contractor work on system components and subsystems to verify the work has been installed to equipment supplier's and industries' standards of alignment, location, etc., to assure proper system operation.
- B. Unless otherwise specified, the CONTRACTOR shall furnish all labor, materials, water, air, oil, power, fuel, chemicals, test equipment and other items required to conduct the field tests, including any retests.
- C. The cost of all field testing shall be included in the Contract Price and no separate payment will be made. The equipment supplier shall detail in his proposal the number of days and trips included as part of the Contract Price, and the Unit Prices for such trips.

1.02 COORDINATION

- A. The equipment supplier shall not proceed with any functional test or operating test until the preliminary operation and maintenance manuals for the equipment have been submitted and been designated "Approved."

1.03 PRE START-UP MAINTENANCE

- A. After installation and prior to start-up, all stored equipment, all grease-lubricated joints, shaft couplings and bearings, etc. shall be flushed out and re-greased by the CONTRACTOR. All oil reservoirs and sumps shall be completely drained and flushed and refilled with the proper lubricant. All operating fluid and gas reservoirs shall be filled with the proper fluid and gases. Screens and filters shall be checked for contamination and replaced if necessary. The equipment shall then be tagged, signed and dated, indicating that the equipment has been properly lubricated or prepared for start-up.

1.04 INSTALLATION INSPECTION

- A. Prior to energizing any piece of equipment or performing a functional test, a factory representative of the equipment or system manufacturer shall inspect the installation of the equipment. The factory representative shall determine if the equipment has been installed in accordance with the manufacturer's recommendations, pre-start-up maintenance has been performed, and is ready

for start-up and the initiation of the functional test. During commissioning, the CONTRACTOR's forces shall be available to make any necessary field adjustments to software, tuning of control loops, adjusting of VFD's, etc. to ensure the system complies with the design specifications.

- B. Should the installation inspection indicate that the equipment has been improperly installed or prepared for start-up, the CONTRACTOR shall provide such modifications or adjustments as required for the equipment to operate properly. The factory representative shall then re-examine the equipment's installation.
- C. The factory representative shall certify that the equipment or system has been installed in accordance with the Drawings, Specifications, and the manufacturer's recommendations and that the equipment is ready for start-up and functional testing to be performed.

1.05 FUNCTIONAL/PERFORMANCE TEST

- A. Following the installation inspection by factory representative, the equipment or system representative shall perform a functional test on each piece of equipment. The functional test shall consist of operation of the equipment on normal duty cycles and through the equipment's anticipated or specified operational range for a sufficient period of time to determine satisfactory operation. Time required for functional testing shall be as specified in the equipment specifications or a minimum one continuous 5-minute period for single pieces of equipment or a minimum continuous 2-hour period for systems, whichever is longer. A lesser time may be used, if requested, and approved in writing. To the maximum extent practical, exercise the full capabilities of all equipment including remote operation, instrumented control schemes, alternate modes of operation and emergency operation.
- B. Should the results of the functional test indicate that the equipment has failed to perform in accordance with the Specifications, the equipment supplier or CONTRACTOR as appropriate shall make, at no additional cost to the OWNER, all modifications or adjustments as required for satisfactory operation, including replacement of any or all components, if necessary. Following the modifications or adjustments, the CONTRACTOR shall repeat the functional test. This procedure shall be repeated until the results of the test indicate that the equipment has satisfied the requirements of the applicable Specification Section.
- C. After the functional test is completed, the manufacturer of each piece of equipment or system shall certify, in writing that tests were made in accordance with the Specifications and the manufacturer's recommendations, that the functional tests and start-up operation have been satisfactory and that the equipment or system is fully operational and capable of meeting operating requirements.
- D. Functional test shall be made using clean or potable water.

- E. For equipment or systems of equipment other than membrane DAF or other complicated systems, the performance test may be included as part of the functional test when requested by the CONTRACTOR and approved by the ENGINEER.

1.06 OPERATING (PERFORMANCE) TEST PERIOD

- A. Following the functional test and where required in the equipment specifications, process performance testing shall be performed in accordance with the requirements of the equipment specifications. The CONTRACTOR shall provide all materials and labor, including the services of a factory representative, necessary to perform the performance testing.
- B. The CONTRACTOR or equipment supplier as appropriate shall repair and make all modifications required due to mechanical failure of the equipment during the performance test period. Should the equipment fail to meet the performance testing requirements, a factory representative shall evaluate the equipment and determine the cause of the process failure. The CONTRACTOR shall make all modifications recommended by the manufacturer.

1.07 CERTIFICATION

- A. Upon completion of start up, the equipment supplier shall provide written certification. Written certification shall indicate that the equipment and sub-systems have been properly installed, that tests were made in accordance with the manufacturer's recommendations, that the test and start-up operation has been satisfactory completed and that the equipment is fully operational under design requirements. Written certification shall be filed with the ENGINEER on the manufacturer's stationery. Once the OWNER and ENGINEER concur, the equipment supplier shall receive Notice of Substantial Completion from the OWNER.

1.08 RELATED WORK

- A. Training is specified in Section 01600 – Special Provisions for Material and Equipment and in the equipment sections.
- B. Operation and maintenance (O&M) manuals are specified in Section 01600.

END OF SECTION

SECTION 02110
SITE CLEARING AND GRUBBING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor and equipment required and perform all clearing, grubbing and stripping of topsoil complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Earth and rock work are included in Section 02200.

1.03 SUBMITTALS

- A. None required for this Section.

PART 2 PRODUCTS

None in this Section.

PART 3 EXECUTION

3.01 GENERAL

- A. The proposed building sites, paved areas, areas designated for ditches and channel changes, borrow pits, etc., (except any portions thereof that may be reserved) shall be cleared of all trees, timber, brush, stumps, rubbish and other debris. All this material, unless otherwise specified, shall be removed and disposed of away from the site.
- B. Open burning is not allowed in Madison County except for agricultural operations.
- C. Where clearing is to be done, stumps shall be grubbed where embankments are less than 5 feet in height, where the profile indicates excavation, in all areas designated for the construction of other facilities and in borrow areas. In all other areas the stumps may be cut off even with the ground. In areas to be grubbed, all stumps and roots must be removed.
- D. No debris will be allowed to be left under or in the embankments.
- E. In felling trees near tracks, structures and wire lines, necessary precaution must be exercised in order to prevent damage to wire lines, structures, the facilities of others, or obstruct tracks.
- F. No extra payment for clearing and grubbing shall be included in the lump sum bid.

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3.02 TREES

- A. Trees (3-inch caliper and larger) shall not be disturbed by construction without written permission from the OWNER, except in those areas to be cleared. Trees disturbed by construction shall be replaced by the CONTRACTOR with same size and type at no additional cost to the OWNER.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor and equipment required to dewater all excavations. Dewatering of all excavations shall be the responsibility of the CONTRACTOR, and no additional compensation will be allowed for same unless specifically included as a bid item.
- B. Leaking pipes and structures are to be anticipated on this project. For this reason, no additional payment will be made for dewatering associated with leakage from any existing facility.

1.02 RELATED WORK

- A. Earthwork is included in Section 02200.
- B. Crushed stone and DGA are included in Section 02235.
- C. Erosion and sedimentation control is included in Section 02270.
- D. Foundation drainage is included in Section 02713.

1.03 SUBMITTALS

- A. None.

PART 2 PRODUCTS

None in this Section.

PART 3 EXECUTION

3.01 GENERAL

- A. Dewatering equipment shall be of adequate size and quantity to assure maintaining proper conditions for installing pipe, concrete, backfill or other material or structure in the excavation. Dewatering shall include proper removal of any and all liquid, regardless of source, from the excavation and the use of all practical means available to prevent surface runoff from entering any excavation.

END OF SECTION

SECTION 02200
EARTH AND ROCK WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Extent of earthwork is indicated on the Drawings.
 - 1. Preparation of subgrade for tanks, basins, building slabs, walks and pavements is included as part of this work.
 - 2. Engineered fill course for support of building or basin slabs is included as part of this work.
 - 3. Backfilling of tanks, basins, basements, and trenches within building lines is included as part of this work.
- B. Excavation for Mechanical/Electrical Work
 - 1. Excavation and backfill required in conjunction with underground mechanical and electrical utilities, and buried mechanical and electrical appurtenances is included as work of this Section.

1.02 RELATED WORK

- A. Dewatering is included in Section 02140.
- B. Crushed Stone and DGA is included in Section 02235.
- C. Foundation Drainage is included in Section 02713.
- D. Sodding and Seeding is included in Section 02930.

1.03 QUALITY ASSURANCE

- A. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Employ, at CONTRACTOR'S expense, testing laboratory acceptable to the OWNER to perform soil testing and inspection service for quality control testing during earthwork operations.

1.04 SUBMITTALS

- A. Submit following reports directly to the ENGINEER from the testing services, with copy to CONTRACTOR:
 - 1. Test reports on borrow material.
 - 2. Verification of each footing subgrade.

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3. Field density test reports.
4. One optimum moisture-maximum density curve for each type of soil encountered.
5. Report of actual unconfined compressive strength and/or results of bearing tests on each strata tested.

1.05 JOB CONDITIONS

A. Site Information

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that OWNER will not be responsible for interpretation or conclusions drawn therefrom by CONTRACTOR. Data are made available for convenience of CONTRACTOR.
2. Additional test borings and other exploratory operations may be made by CONTRACTOR at no cost to OWNER.

B. Existing Utilities

1. Prior to commencement of work, the CONTRACTOR shall locate existing underground utilities in areas of the work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

C. Use of Explosives

1. The CONTRACTOR (or any of his subcontractors) shall not bring explosives onto site or use in work without prior written permission from the OWNER. All activities involving explosives shall be in compliance with the rules and regulations of the Kentucky Department of Mines and Minerals, Division of Explosives and Blasting. CONTRACTOR is solely responsible for handling, storage, and use of explosive materials when their use is permitted.
2. In all blasting operations, the maximum peak particle velocity of the ground motion in any direction shall not exceed 2 inches per second at the immediate location of any dwelling house, public building, school, church, commercial or institutional building and the particle velocity at such location immediately after a period of 1 second following the peak particle velocity produced by any charge shall not exceed ½ inch per second.

D. Protection of Persons and Property

1. Barricade open excavations occurring as part of this work and post with warning lights.

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2. Operate warning lights as recommended by authorities having jurisdiction.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

A. Definitions

1. Satisfactory soil materials are defined as those complying with ASTM D2487-85 soil classification groups GW, GP, GM, SM, SW, SP, GC, SC, ML, and CL.
2. Unsatisfactory soil materials are defined as those complying with ASTM D2487-85 soil classification groups MH, CH, OL, OH and PT.
3. Subbase material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.
4. Drainage fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 4 sieve.
5. Backfill and fill materials: Satisfactory soil materials free of debris, waste, frozen materials, vegetable, and other deleterious matter.
6. Engineered fill: (Refer to this Section, paragraph 3.07.)

PART 3 EXECUTION

3.01 STRIPPING AND TOPSOILING

- A. Before excavation and grading is commenced for buildings, structures or other work described hereinafter (except pipelines and manholes) or before material is removed from borrow pits, the material meeting the topsoil specification in Section 02930 of these Specifications shall be removed from the areas affected and stockpiled.
- B. When final grading is accomplished, particularly around buildings and other structures, the topsoil shall be spread evenly over the excavated area. Rough grading above excavated areas shall have been carried approximately 6 inches below finished grade (except solid rock, where it shall be carried 12 inches below finished grade) and brought back up to grade with topsoil as set out herein.

3.02 EXCAVATION

- A. Excavation includes excavation to subgrade elevations indicated including excavation of earth, rock, bricks, wood, cinders, and other debris. All excavation of materials in the lump sum portion of the work will be unclassified and no additional payment will be made regardless of type material encountered.
- B. Differing Site Conditions
 - 1. Refer to Section 00700, paragraph 17.
- C. Excavation Classifications
 - 1. The following classifications of excavation will be made when unanticipated material is encountered in work:
 - a. Earth excavation includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.
 - b. Rock excavation in trenches and pits includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42 inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 345C, rated at not less than 345 Hp flywheel power and 44,000 pound drawbar pull. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.
 - c. Rock excavation in open excavation includes removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with modern track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock excavation equipment is defined as Caterpillar Model 973 with rock bucket, or equivalent track-mounted loader, rated at not less than 242 Hp flywheel power and developing 40,000 pound break-out force (measured in accordance with SAE J732C).
 - (1) Typical of materials classified as rock are boulders ½ cubic yard or more in volume, solid rock, rock in ledges and hard cementitious aggregate deposits. Rock material encountered will be classified as rock excavation.
 - (2) Intermittent drilling, blasting, or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

D. Unauthorized excavation consists of removal of materials beyond subgrade elevations or dimensions without specific direction of ENGINEER. Unauthorized excavation, as well as remedial work directed by ENGINEER, shall be at CONTRACTOR's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to the ENGINEER.
2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification.

E. Additional Excavation

1. When excavation has reached required subgrade elevations, notify the ENGINEER who will make an inspection of conditions.
 - a. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed in writing by the ENGINEER.
 - b. Removal of unsuitable material and its replacement as directed will be paid on basis of Contract conditions relative to changes in work.

F. Stability of Excavations

1. Slope sides of excavations to comply with codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

G. Shoring and Bracing

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross-braces, in good serviceable condition.
2. Establish requirements for trench shoring and bracing to comply with codes and authorities having jurisdiction.
3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
4. Provide permanent steel sheet piling or pressure creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required and leave permanently in place. In the event the OWNER directs the

CONTRACTOR to leave shoring materials in place, the OWNER will reimburse the CONTRACTOR for the reasonable cost of leaving such materials in place.

H. Dewatering

1. Refer to Section 02140 for dewatering requirements.

I. Material Storage

1. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
2. Dispose of excess soil material and waste materials as herein specified.

J. Excavation for Structures

1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
2. In excavating for footings and foundations, take care not to disturb bottom of excavation. All loose material shall be removed from the excavation just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

K. Excavation for Pavements

1. Cut surface under pavements to comply with cross-sections, elevations, and grades as shown.

L. Trench Excavation

1. The CONTRACTOR shall include in his lump sum bid all trenching and backfill necessary for installation of all pipelines as planned and specified unless specific unit prices are set up for specific pipeline. Trenching shall include clearing and grubbing of all trash, weeds, briars, trees and stumps encountered in the trenching. The CONTRACTOR shall dispose of such material at no extra cost to the OWNER. Shrubs shall be removed, maintained and replanted in the same or adjacent location. Trenching also includes such items as railroad, street, road, sidewalk, pipe, and small creek crossings; cutting, moving or repairing damage to fences, posts, gates, and other surface structures regardless of whether shown on the Drawings.
2. All existing facilities shall be protected from danger or damage while pipelines are being constructed and backfilled, and from damage due to settlement of the backfill.
3. In the event any existing structure is damaged, repair and restoration shall be made at once and backfill shall not be replaced until this is done.

Restoration and repair shall be such that the damaged structure is equal to or better than its original condition and can serve its purpose as completely as before. All such restoration and repair shall be done without extra cost to the OWNER.

4. Trenches must be dug to lines and grades shown on the Drawings. Hand trenching may be required in areas where machine trenching would result in undue damage to existing structures and facilities.
5. Excavation shall be open trenches, except where otherwise shown on the Drawings, for tunneling, boring, or jacking under structures, railroad, sidewalks and roads.
6. Sheeting and shoring of trenches shall be provided at the expense of the CONTRACTOR where necessary to protect life, property and the new or existing structures from damage or to maintain maximum permissible trench widths at top of pipe. All necessary materials, including, but not limited to, sheeting, sheet piling, trench jacks, braces, shores and stringers, shall be used to hold trench walls. Sheeting and shoring may be withdrawn as the trenches are being backfilled, after backfill has been tamped over top of the pipe at least 18 inches. If removal before backfill is completed to surface endangers adjacent structures, such as buildings, pipelines, street paving, and sidewalks, then the sheeting and shoring shall be left in place until such danger has passed, and then pulled if practical. Voids caused by sheeting withdrawal shall be backfilled and tamped. If not withdrawn, sheeting shall be cut off at least 18 inches below final surface grade, so there is no obstruction at the ground level. In the event the OWNER directs the CONTRACTOR to leave shoring materials in place, the OWNER will reimburse the CONTRACTOR for the reasonable cost of leaving such materials in place.
7. Where subgrade of trench has insufficient stability to support the pipeline and hold it to its original grade, the ENGINEER may order stabilization by various means. Exclusive of dewatering normally required for construction, and instability caused by neglect of the CONTRACTOR, the necessary stabilization shall be paid for at unit prices established in the Contract. In the event no particular bid price is applicable, then the payment for stabilization will be negotiated.
8. The location of the pipelines and their appurtenances as shown are those intended for the final construction. However, conditions may present themselves before construction on any line is started that would indicate desirable changes in location. The OWNER reserves the right to make reasonable changes in line and structure locations without extra cost, except as may be determined by extra units of materials and construction actually involved. The OWNER is under no obligation to locate pipelines, so they may be excavated by machine.
9. Tunneling may be used at the CONTRACTOR'S option as an alternate to open-cut trenching, at no extra cost to the OWNER. The annular space between plates and excavation shall be either permanently placed pea

gravel or sand, pumped grout (3 parts sand and 1 part Portland cement by volume) or other suitably installed material approved by the ENGINEER. Backfilling shall be kept close to the heading and completed after each day's work. Where grout is used for backfill, injection holes with threaded plugs shall be provided in liner plates at various levels and in sufficient number to effectively grout the void around the tunnel. A minimum of 3 grout holes shall be provided in each 8 feet of tunnel length. Grout shall be injected in the lower holes first, proceeding upward as the void is filled. Plugs shall be installed after each hole is filled and grout stops shall be provided behind plates as necessary to ensure complete filling of the void. In tunneling under buildings, the CONTRACTOR will be responsible for all damage resulting from his operations and methods of excavation and backfilling. Boring may also be used at the CONTRACTOR'S option as an alternate to tunneling or open-cut trenching, at no extra cost to the OWNER.

10. Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room. Provide 6-inch to 9-inch clearance on both sides of pipe or conduit.
 - a. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
 - b. Where rock is encountered, carry excavation 6 inches below required elevation and backfill with a 6-inch layer of crushed stone or gravel prior to installation of pipe.
 - c. For pipes or conduit 4 inches or smaller in nominal size, excavate to subbase depth indicated or, if not otherwise indicated, to 4 inches below bottom of work to be supported.
 - d. For pipes or conduit 6 inches or larger in nominal size, tanks, and other mechanical/electrical work indicated to receive subbase, excavate to subbase depth indicated or, if not otherwise indicated, to 6 inches below bottom of work to be supported.
 - e. Except as otherwise indicated, excavation for exterior water-bearing piping (water, steam, condensate, drainage) so top of piping is no less than 2 feet 6 inches below finish grade.
 - f. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
 - g. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.

- h. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the ENGINEER. Use care in backfilling to avoid damage or displacement of pipe systems.
- i. For piping or conduit less than 2 feet 6 inches below surface of roadways, furnish and install steel casing pipe, minimum wall thickness of 1/4-inch, of sufficient diameter to carry the pipe or conduit to at least 2 feet beyond outside edge of pavement.

M. Cold Weather Protection

- 1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit (1 degree Celsius).

3.03 COMPACTION

A. General

- 1. Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below:
 - a. Percentage of maximum density requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D698; and not less than the following percentages of relative density, determined in accordance with ASTM D4253 and D4254, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - b. Structures, building slabs and steps, pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent standard proctor density at +2 percent to -2 percent optimum moisture content.
 - c. Lawn or unpaved areas: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90 percent standard proctor density.
 - d. Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material at 95 percent standard proctor density at +2 percent to -2 percent optimum moisture content.

B. Moisture Control

- 1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface or subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.
- 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

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3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.04 BACKFILL AND FILL

A. General

1. Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below. Backfill material shall be no larger than the specified depth of the layer to be placed and/or compacted.
 - a. In excavations, use satisfactory excavated or borrow material.
 - b. Under grassed areas, use satisfactory excavated or borrow material.
 - c. Under walks and pavements, use subbase material, or satisfactory excavated or borrow material, or combination of both.
 - d. Under steps, use subbase material.
 - e. Under building slabs, use subbase material for a minimum depth of 6 inches.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Inspection, testing, approval, and recording locations of underground utilities.
3. Removal of concrete formwork.
4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
5. Removal of trash and debris.
6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

C. Ground Surface Preparation

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.

Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

2. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum density.

D. Placement and Compaction

1. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Crushed stone shall be installed in accordance with Section 02235.
2. Before compaction, add moisture or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
3. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

E. Backfilling Trenches

1. Refer to Section 02610 or Section 02700 as appropriate for trench backfill requirements.

3.05 GRADING

A. General

1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines

1. All materials used for backfill around structures shall be of a quality acceptable to the ENGINEER and shall be free from large or frozen lumps, wood and other extraneous material. All spaces excavated and not occupied by footings, foundations, walls or other permanent work shall be refilled with earth up to the surface of the surrounding ground, unless otherwise specified, with sufficient allowance for settlement.

2. In making the fills and terraces around the structures, the fill shall be placed in layers not exceeding 12 inches in depth and shall be kept smooth as the work progresses. Each layer of the fill shall be rolled with an approved type roller and/or be compacted. When it is not practicable to compact sections of the fill immediately adjacent to buildings or structures by rolling, then such sections shall be thoroughly compacted by means of mechanical tamping or hand tamping as may be required by the conditions encountered.
3. All fills shall be placed so as to load structures symmetrically.
4. As set out hereinbefore, rough grading shall be held below finished grade and then the topsoil which has been stockpiled shall be evenly spread over the surface. The grading shall be brought to the levels shown on the Drawings or to the elevations established by the ENGINEER. Final dressing shall be accomplished by hand work or machine work, or a combination of these methods as may be necessary to produce a uniform and smooth finish to all parts of the regrade. The surface shall be free from clods greater than 2 inches in diameter. Excavated rock may be placed in the fills, but it shall be thoroughly covered. Rock placed in fills shall not be closer than 12 inches from finished grade.
5. Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
 - a. Finish surfaces to be free from irregular surface changes, and as follows:
 - (1) Lawn or unpaved areas: Finish areas to receive topsoil to within not more than 0.10 feet above or below required subgrade elevations.
 - (2) Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.0 inch above or 1.0 inch below required subgrade elevation.
 - (3) Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 0.0 inch above or 1 inch below required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs

1. Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 0.0 inch above or 1 inch below required subgrade elevation when tested with a 10-foot straightedge.

D. Compaction

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1. After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or standard proctor density for each area classification.

3.06 PAVEMENT SUBBASE COURSE

A. General

1. Subbase course consists of placing subbase material, in layers of specified thickness, over subgrade surface to support a pavement base course.

B. Grade Control

1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders

1. Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12-inch width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing

1. Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
2. When a compacted subbase course is shown to be 6 inches thick or less, place material in a single layer. When shown to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

3.07 BUILDING SLAB ENGINEERED FILL COURSE

A. General

1. Engineered fill course consists of placement of crushed stone of size and type shown on Drawings, in layers of indicated thickness, over subgrade surface to support concrete building slabs.

B. Placing

1. Place fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.

2. When a compacted course is shown to be 6 inches or less, place material in a single layer. When shown to be more than 6 inches thick, place material in equal layers, except no single layer shall be more than 6 inches or less than 3 inches in thickness when compacted.

3.08 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction

1. Allow testing service to inspect and report to the ENGINEER on findings and approve subgrades and fill layers before further construction work is performed. A minimum of 3 tests per layer shall be performed on compacted soil fill. The placement of rock for the purpose of structure fill shall be observed and approved by testing service.
 2. Perform field density tests in accordance with ASTM D1556 (sand cone method), ASTM D2167-84 (rubber balloon method), or ASTM D2992-87 (nuclear density method), as applicable.
 3. Footing subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.
 4. Paved areas and building slab subgrade: Make at least one field density test of subgrade for every 2,000 square feet of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 square feet of overlaying building slab or paved area, but in no case less than three tests.
 5. Foundation wall backfill: Take at least 2 field density tests, at locations and elevations as directed.
- B. If in opinion of the ENGINEER, based on testing service 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.

3.09 MAINTENANCE

A. Protection of Graded Areas

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas

1. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

C. Settling

1. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.10 DISPOSAL OF EXCESS NON-ORGANIC SOIL AND ROCK

A. General

1. The OWNER'S property as designated on the Drawings and/or specified herein shall be used for disposal of all acceptable excess excavated material, including acceptable demolition materials. The CONTRACTOR shall place and compact all acceptable excess excavated and/or demolition material at this location, with the cost of hauling, placing, compacting and covering, included in the CONTRACTOR'S lump sum bid.

B. Material Classification and Description

1. Acceptable fill material shall consist of all excess non-organic soil and rock available at the site. The non-organic soil and rock may be composed of earth, shale, limestone, weathered rock, waste crushed aggregate or other approved materials. Excess non-organic soil and rock shall contain no particle whose largest dimension exceeds 12 inches.

C. Foundation Preparation

1. The CONTRACTOR shall proof roll the fill area a minimum of 2 passes. Any soft spots found shall be removed prior to fill placement.

D. Placement

1. The distribution and gradation of material throughout the fill shall be such that the fill will be free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material. The combined excavation and placing operations shall be such that the materials when compacted in fill will be blended sufficiently to secure the best practicable degree of compaction and stability. Successive loads of material shall be placed on the fill so as to produce the best practicable distribution of the material.
2. The material shall not be dumped into final position but shall be distributed by blading or dozing in a manner that will ensure proper placement in the embankment so that voids, pockets and bridging will not occur.
3. No fills shall be placed upon a frozen surface, nor shall snow, ice or frozen materials be incorporated in the fill.

E. Spreading and Compacting

1. The material shall be spread in uncompacted lifts 12 to 16 inches in thickness, depending on the amount of earth, over the entire length and width of the specified area. The material shall then be compacted by a minimum of 6 passes of a smooth drum vibratory roller. The roller shall have a total static weight of not less than 20,000 pounds. The diameter of the drum shall be between 5.0 and 5.5 feet and the width between 6.0 and 6.5 feet. The frequency of vibration during operation shall be between 1,200 and 1,500 vibrations per minute and the dynamic force at 1,400 vibrations per minute shall not be less than 16,000 pounds. Rollers shall be operated at speeds not to exceed 1.5 miles per hour.

F. Earth Cover

1. The surface of the waste area shall be covered with a minimum of 12 inches of material suitable for growing grass, trees, shrubs, etc., and shall be relatively free of rocks and other debris, satisfactory to the OWNER. The material shall be placed and spread in accordance with this Specification.

END OF SECTION

SECTION 02235

CRUSHED STONE AND DENSE GRADED AGGREGATE (DGA)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install crushed stone aggregates and DGA as indicated on the Drawings and/or required in the Specifications for such uses as surfaces and/or bases of roads, parking areas and walkways; temporary and permanent traffic bound surfacing over trenches; permanent traffic bound roadway surface maintenance; replacement of unsuitable material; and other miscellaneous applications required in the work.
- B. Various sizes, types and quality of crushed stone aggregates are specified in this Section depending on applicability which may be specified in detail in other sections of these Specifications.
- C. The ENGINEER may require the use of crushed stone aggregates for purposes other than those specified in this or other Specification sections if such use is advisable in his opinion. Payment for crushed stone aggregate shall be by negotiation unless agreed pricing has been previously established.

1.02 RELATED WORK

- A. Dewatering is included in Section 02140.
- B. Earthwork is included in Section 02200.

1.03 SUBMITTALS

- A. Testing Service shall submit required test reports directly to the ENGINEER with copy to CONTRACTOR.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Crushed stone aggregate shall meet the applicable requirements for the intended use in accordance with Section 805 of the Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction.
- B. Unless otherwise referred to on the Drawings or in these Specifications, crushed stone aggregate shall be graded size No. 57 according to the table below.
- C. When referred to on the Drawings or in these Specifications, dense graded aggregate (DGA) shall have a sand equivalent value of not less than 25 and shall be graded according to the table below.

D. Coarse aggregate gradations referred to by number size on the Drawings or in these Specifications shall conform to the following table (as copied from the above Kentucky Transportation Cabinet Specifications, Table 805.07, 1994 Edition):

Size	Max. Size Square Openings (1)	AMOUNTS FINER THAN EACH LABORATORY SIEVE (SQUARE OPENINGS) PERCENTAGE BY WEIGHT																	
		100 (4)	90 (3 1/2)	75 (3)	63 (2 1/2)	50 (2)	37.5 (1-1/2)	25 (1)	19 (3/4)	12.5 (1/2)	9.5 (3/8)	4.75 (No. 4)	2.36 (No. 8)	2 (No. 10)	1.18 (No. 16)	600 (3) (No. 30)	425 (3) (No. 40)	150(3) (No. 100)	75 (3) (No. 200)
1	90 (3 1/2)	100	90-100		25-60		0-15		0-5										
2	63 (2 1/2)			100	90-100	35-70	0-15		0-5										
23	63 (2 1/2)			100		40-90		0-15		0-5									
3	50 (2)				100	90-100	35-70	0-15		0-5									
357	50 (2)				100	95-100		35-70		10-30		0-5							
4	37.5 (1-1/2)					100	90-100	20-55	0-15		0-5								
467	37.5 (1-1/2)					100	95-100		35-70		10-30	0-5							
5	25 (1)						100	90-100	20-55	0-10	0-5								
57	25 (1)						100	95-100		25-60		0-10	0-5						
610	25 (1)						100	85-100		40-75		15-40							
67	19 (3/4)							100	90-100		20-55	0-10	0-5						
68	19 (3/4)							100	90-100		30-65	5-25	0-10		0-5				
710	19 (3/4)							100	80-100		30-75	0-30							
78	12.5 (1/2)								100	90-100	40-75	5-25	0-10		0-5				
8	9.5 (3/8)									100	85-100	10-30	0-10		0-5				
9-M	9.5 (3/8)									100	75-100	0-25	0-5						
10	4.75 (No. 4)										100	85-100						10-30	
11	4.75 (No. 4)										100	40-90	10-40					0-5	
DGA(2)	19 (3/4)							100	70-100		50-80	30-65				10-40			2-10
GRAVEL BASE(2)	37.5 (1-1/2)					100						25-65					6-30	5-20	
CSB(2)	50 (2)				100		90-100		60-95		30-70	15-55				5-20			0-8

(1) Nominal size in mm (inches), unless otherwise shown

(2) Gradation performed by wet sieve KM 64-420

(3) micrometers

E. Testing

1. Unless otherwise required in this Section, the ENGINEER shall determine the tests required for crushed stone aggregates according to Section 805. The CONTRACTOR shall be responsible, initially and periodically at no cost to the OWNER, to deliver materials proposed for use or being used in the work to a testing laboratory selected by the OWNER. This provision shall apply to any other aggregate tests required in this Section.
2. The OWNER shall be responsible to pay the laboratory testing costs. However, once a material has been tested and accepted for use, the CONTRACTOR shall be responsible throughout the job to use materials which are equal in all respects and from the same source as that accepted material delivered to the testing laboratory.
3. The CONTRACTOR shall pay for additional tests ordered by the ENGINEER after acceptance of tested materials when such tests show the quality of materials has become deficient or when the CONTRACTOR requests a change of material supplier and/or source.

4. The ENGINEER shall request tests on Form HKB DE-16 "Requisition for Material and Design Mix Tests."

PART 3 EXECUTION

3.01 INSTALLATION

A. Compacted Crushed Stone Aggregate

1. Crushed stone shall be placed in uniform layers not greater than 6 inches deep and shaped by power equipment to required lines, grades, cross connections, and depths. No minimum compacted density, method of compaction, or compaction equipment is required since a nominal amount of compaction effort with vibration can establish the desired intergranular locking of the aggregate under controlled placement depth. Acceptable compaction can be achieved with pneumatic-tired and tracked equipment and rollers.
2. All compaction operations shall be performed to the satisfaction of the ENGINEER.
3. Crushed stone shall be placed in those areas as shown on the Drawings and as may be directed by the ENGINEER.

B. Compacted Dense Graded Aggregate (DGA)

1. Dense graded aggregate shall be plant mixed with water, transported in such a manner as to deliver the mix to the project without loss or segregation, spread, and compacted to produce a density throughout not less than 84 percent of solid volume. Minimum dry density for compacted limestone DGA shall be 139 pounds per cubic foot when S.G. of limestone is 2.65.
2. Density tests shall be required in such number as determined by the ENGINEER. Density tests shall be made by the sand cone method or by nuclear gauges. The CONTRACTOR shall furnish all necessary labor, equipment and materials for making the density tests under observations of the ENGINEER.
3. In the event compacted material does not meet the required density of an area, the CONTRACTOR shall either continue compaction efforts or rework the entire area until the required density is obtained. If material has to be removed and reworked, the ENGINEER shall determine if removed material can be remixed and used again for fill.
4. All compacted DGA fill shall be included in the CONTRACTOR'S lump sum bid unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 02270

GEOTEXTILES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to install geotextiles as shown on the Contract Drawings and as specified herein.

1.02 RELATED WORK

[Per project spec. writer]

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit to the ENGINEER in accordance with Section 00700 (00710) of the Specifications detailed material, performance and installation information on the geotextile fabric proposed for use. The ENGINEER shall review the submittal for acceptability prior to shipment of the fabric to the job site.

PART 2 PRODUCTS

2.01 MATERIAL

- A. The geotextile fabric shall consist of long chain polymeric filaments of either polyester or polypropylene formed into a stable network. Fabric shall be tear and puncture resistant and maintain the following minimum physical properties, when wet or dry, and be inert to commonly encountered chemicals in the soil.
- B. The geotextile fabric shall meet the following minimum requirements:

<u>Property</u>	<u>Requirement</u>	<u>Specification</u>
Weight	4.0± 0.5 oz./sq.yd.	---
Grab Tensile	110 lbs.	ASTM D 1682-64 (1975)
Modulus	900 lbs.	ASTM D 1682-64 (1975)
Trapezoidal Tear	40 lbs.	ASTM D 2263-68
Mildew, Rot Resistance	100%	---
Coeff. of Permeability (K)	1 x 10 ⁻³ cm/sec.	EURM-100

- C. The fabric shall be TYPAR Style 3401 as manufactured by DuPont, Wilmington, Delaware; Bidim as manufactured by Monsanto Textiles Co., St. Louis, Missouri, or equal, unless otherwise specified or shown on the Drawings.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. The fabric shall be installed as recommended by the manufacturer for the application specified and/or shown on the Drawings. Manufacturer's printed instructions shall be strictly followed including storage of fabric rolls; subgrade preparation to prevent puncture; unrolling and positioning fabric; installing loosely to allow for settlement without rupture under crushed rock and riprap fills; and fabric lap distances which shall be a minimum of 1 foot unless otherwise required.

END OF SECTION

SECTION 02370

EROSION PREVENTION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies erosion prevention and sedimentation control during construction.

1.02 RELATED SECTIONS

- A. Section 02930 – Sodding and Seeding
- B. Section 02200 – Earth and Rock Work
- C. Section 02270 - Geotextiles

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit a copy of the NOI to the local municipality, the Kentucky Division of Water, and the ENGINEER.
- B. The CONTRACTOR shall use the preliminary BMP plan supplied by the ENGINEER in this Section and adjust it as needed and as stated therein for the actual site conditions. A copy of the revised BMP plan shall be sent to the OWNER and the ENGINEER.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect material from the weather during transit and storage.

PART 2 – PRODUCTS

2.01 MATERIALS

- 1. Kentucky Erosion Prevention and Sediment Control Field Guide
- 2. Best Management Practices Plan.

2.02 BEST MANAGEMENT PRACTICES PLAN

- A. Richmond Utilities Board Water Treatment Plant
 - 1. This National Pollutant Discharge Elimination System (NPDES) Best Management Practices (BMP) plan was developed in accordance with EPA requirements, the Kentucky Erosion Prevention and Sediment Control Field Guide (KEPSCFG) and good engineering practices for the water treatment plant project. A copy of the Kentucky Erosion Prevention and Sediment Control Field Guide can be downloaded from the Kentucky

Division of Water website www.water.ky.gov/permitting/wastewaterpermitting/KPDES/storm/. The BMP plan identifies the potential sources of pollution that may reasonably be expected to affect the quality of storm water discharges from the project. The BMP plan provides the proper guidance for the CONTRACTOR to ensure the implementation of practices that are to be used to reduce the pollutants in storm water discharges and to assure compliance with the terms and conditions of the KPDES permit. The CONTRACTOR must implement the BMP plan as a condition of the KPDES permit.

2. Site Description

- a. The construction of the water treatment plant backup power system is the cause of the site disturbance. When complete the project will provide backup power for the treatment plant. a
- b. The sequencing of major soil disturbing operations will proceed as follows:
 - 1) Installation of perimeter erosion and sediment controls.
 - 2) Clearing and grubbing of proposed disturbed areas.
 - 3) Excavation and site grading for new structures and waterlines.
 - 4) Existing vegetation shall be preserved where possible.
 - 5) Stabilization shall begin within 14 days on areas that have been disturbed and construction activity has ceased.
- c. The site construction activity will result in the disturbance of approximately 1 acre over 1 site. All construction is in Madison County, Kentucky. The post-construction runoff coefficient (C-factor) is calculated as 0.15.
- d. The water quality of runoff generated and discharged from the site is very good. The watershed is a mixture of agricultural/pasture and tree covered hills. The watershed is also situated within a region of karst topography, which results in increased storm water infiltration and groundwater recharge due to the preferential flow paths associated with karst systems. The increased infiltration aids in water quality since the soil acts as a filtering and treatment mechanism to remove sediment and pollutants from the storm water. Runoff that does discharge from the water treatment plant site eventually flows into the Kentucky River.

3. Sediment and Erosion Control Measures:

- a. The BMP plan includes a clear description of what sediment and erosion control measures will be used and when they will be

implemented. Perimeter controls will be installed after the clearing and grubbing necessary for their installation, but before clearing and grubbing the remaining portions of the site. Perimeter controls, as described below, will be actively maintained until upward portions of the site are stabilized.

- b. Silt fence reinforced with hog wire or similar diversion method as indicated in the KEPSCFG will be installed in swales. This will act as a flow diverter to route the clean water away from the construction site. The stakes used to anchor the filter fabric should be wood or metal. Wooden stakes should be at least 5 feet long and have a minimum diameter of 2 inches if a hardwood like oak is used. Stakes from soft woods like pine should be at least 4 inches in diameter. When using metal posts in place of wooden stakes, they should weigh at least 1.00 to 1.33 lb/linear foot. If metal posts are used, attachment points are needed for fastening the filter fabric with wire ties.
- c. Erect silt fence in a continuous fashion from a single roll of fabric to eliminate gaps in the fence. If a continuous roll of fabric is not available, overlap the fabric from both directions only at stakes or posts. Overlap at least 6 inches. Excavate a trench to bury the bottom of the fabric fence at least 6 inches below the ground surface. This helps to prevent gaps from forming near the ground surface. Gaps would make the fencing useless as a sediment barrier.
- d. The height of the fence posts should be 16 to 34 inches above the original ground surface. If standard-strength fabric is used with wire mesh, space the posts no more than 10 feet apart. If extra-strength fabric is used without wire mesh reinforcement, space the posts no more than 6 feet apart (VDCR, 1995).
- e. The fence should be designed to withstand the runoff from a 10-year peak storm event. Once installed, it should remain in place until all areas upslope have been permanently stabilized by vegetation or other means.
- f. The following is a list of control measures that may be used as conditions dictate.
 - 1) Soil Stabilization Practices - Existing vegetation shall be preserved where possible. All disturbed areas of the site shall be stabilized. Stabilization shall begin within 14 days on areas of the site where construction activities have permanently or temporarily (for 21 days or more) ceased. When snow cover causes delays, stabilization shall begin as soon as possible.

Stabilization practices include seeding, mulching, placing sod, planting trees or shrubs, and using geotextile fabrics and other appropriate measures.

The CONTRACTOR will assume the responsibility for proper selection, application, and maintenance of appropriate soil stabilization practices.

- 2) Additional Perimeter Structural Practices - Silt fences or other equivalent structural practices shall be used on all side and down slope borders of the site. Alternatively, a sediment basin shall be used that provides 3,600 cubic feet of storage capacity per disturbed acre drained.

Structural practices include protecting drain inlets and outlets and using silt fences, earthen dikes, drainage swales, sediment traps, check dams, subsurface drains, pipe slope drains, reinforced soil retaining systems, gabions, sediment basins and other appropriate measures. The installation of these devices may be subject to Section 404 of the CWA.

The CONTRACTOR will assume the responsibility for proper selection, application, and maintenance of appropriate perimeter structural practices.

- 3) Storm Water Management Devices - Management devices shall be installed during construction to control the pollutants in storm water discharges that will occur after construction has been completed. Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive flow so that the original physical and biological characteristics and functions of the receiving waters, such as the hydroperiod and hydrodynamics, are maintained and protected. When considering storm water management devices, the goal should be 80 percent removal of Total Suspended Solids that exceed predevelopment levels. If this goal is not met, the OWNER shall provide justification for refusing each device based on site conditions.

Management devices include velocity dissipation devices, storm water retention and detention basins, wet ponds, vegetated swales and natural depressions used for flow reduction, runoff infiltration devices, sequential systems that combine several devices and other appropriate measures. The installation of these devices may be subject to Section 404 of the CWA.

The CONTRACTOR will assume the responsibility for proper selection, application, and maintenance of appropriate storm water management devices.

The CONTRACTOR is not responsible for the maintenance of these devices once discharges associated with construction activity have been eliminated.

4. Other Control Measures

- a. No solid materials, including building materials, shall be discharged to waters of the Commonwealth, except as authorized by a Section 404 permit.
- b. Off-site vehicle sediment tracking and dust generation shall be minimized.
- c. Waste disposal methods and sanitary sewer or septic systems shall comply with applicable state or local regulations.
- d. The CONTRACTOR will assume the responsibility for taking the actions necessary to comply with the requirements listed in this section.

5. Other State or Local Plans

- a. Compliance with the BMP plan shall include satisfying any requirements specified in sediment and erosion control plans, storm water management plans or permits that have been approved by other state or local officials. Upon submittal of the NOI, other requirements for surface water protection are incorporated by reference into and are enforceable under this permit (even if they are not specifically included in the BMP plan). This provision does not apply to master or comprehensive plans, non-enforceable guidelines or technical guidance documents that are not identified in a specific plan or permit issued for the construction site by state or local officials.
- b. The OWNER or authority having jurisdiction will supply copies of any other applicable permits/plans and their requirements that must also meet compliance, and make the CONTRACTOR aware of the conditions of this section.

6. Maintenance

- a. The requirements of this BMP plan include utilizing proper maintenance procedures necessary to keep the control measures in good and effective operating condition. The CONTRACTOR shall refer to the project plans and specifications for erosion and sediment control, and manufacturer's specifications for guidance related to maintenance.

7. Inspections

- a. Qualified personnel shall inspect all storm water control measures, discharge locations, vehicle exits, disturbed areas of the construction site and material storage areas at least once every seven (7) days (and within 24 hours of the end of a storm that is 0.5 inches or greater) and areas that have been temporarily or finally stabilized at least once a month. Revisions to the BMP plan based on the results of the inspection shall be implemented within seven (7) days.
- b. Control measures shall be inspected to ensure correct operation. Accessible discharge locations shall be inspected to ensure that velocity dissipation devices are effective in preventing significant impacts to receiving waters. Vehicle exits shall be inspected for evidence of, or the potential for, off-site sediment tracking. Disturbed areas and material storage areas that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system.
- c. A report summarizing the scope of the inspection, names and qualifications of personnel making the inspection, the date of the inspection, major observations relating to the implementation of the BMP plan, and any corrective actions taken shall be made and kept as part of the BMP plan for at least three (3) years after the date of inspection, or until one (1) year after coverage under this permit ends. The person conducting the inspection must sign the inspection form.

8. Non-Storm Water Discharges

- a. All discharges from this construction site are storm water related and do not mix with storm water discharges from other industrial activities.

9. Contractors and Subcontractors

- a. This BMP plan has been included in the contract documents for the CONTRACTOR'S use during bidding this project. The selected CONTRACTOR and their subcontractors are hereby made aware that they must clearly state the CONTRACTOR or subcontractors that will implement each control measure identified in the BMP plan after the contract has been awarded. All contractors and subcontractors identified in the BMP plan must sign a copy of the certification statement on the following page in accordance with PART II of the KPDES permit before conducting any professional service at the site.

10. Other Activities That Have Potential to Pollute Groundwater or Surface Runoff

Below are a series of activities that create the potential for groundwater or storm water runoff contamination.

- a. Tank Storage
 - 1) N/A
- b. Transfer, Loading, and Unloading
 - 1) Transfer, loading, and unloading areas for fuel (gasoline and diesel), oil, and hydraulic fluid.

11. Practices Selected to Protect Groundwater and Storm Water Runoff from Pollution

This section is organized to address the sets of practices in place for each general activity listed above. Most practices for a given type of activity (tank storage, for example) are common to all items listed under that heading. Therefore, to avoid redundancy, these common practices are only listed once within a subheading and apply to all items listed within a general activity group. Where practices apply to individual items, a separate description is included identifying the item and the practice utilized. One additional subheading is included to cover practices that can apply to all aspects of the construction site.

- a. Tank Storage Protection Practices (Storage of fuel, oil, and hydraulic fluid)
 - 1) Notify Site Superintendent upon discovery of the problem. Notify other officials and/or agencies as necessary dependent on the nature of the situation.
 - 2) All fuel, fluid and oil tanks have secondary containment structures.
 - 3) Rainwater built up in secondary containment structures must be checked for presence of sheen prior to release. If sheen is present, the water must be considered hazardous waste, pumped into a compatible container and disposed of via a certified hazardous waste disposal company.
 - 4) Personnel are trained to exercise due caution when filling or dispensing of fuels and oils to avoid spillage. Personnel are to be instructed to avoid overfilling tanks. Spills are to be cleaned up immediately upon occurrence or notification that one has occurred.
 - 5) Spills shall be cleaned up using absorbent materials such as Oil Pickup (a dry powder). Contaminated soil will be removed and disposed of at a landfill approved for disposal

of such waste or contacting an environmental remediation company for advice on disposal.

b. Transfer, Loading, and Unloading Protection Practices

- 1) Notify Site Superintendent upon discovery of the problem. Notify other officials and/or agencies as necessary dependent on the nature of the situation.
- 2) All oil and fuel locations have secondary containment structures.
- 3) Personnel are trained in proper containment, clean-up, and disposal procedures in the event of an accidental spill. If the spill is large enough an earthen berm will be constructed to contain the spill. Phone calls to the Project Manager and the KY Environmental Response Center shall be made in the event of a significant spill. Contaminated soil will be removed and disposed of at a landfill approved for disposal of such waste or contacting an environmental remediation company for advice on disposal.
- 4) Small spills cleaned with rags or other absorbent material (Oil Pickup) require proper disposal of the contaminated material by placing it in a plastic bag prior to disposal in the dumpster.
- 5) Personnel are trained to exercise due caution when filling or dispensing from fuel and oil tanks to avoid spillage. Personnel are to be instructed to avoid overfilling tanks. Spills are to be cleaned up immediately upon occurrence or notification that one has occurred.

12. Emergency Contacts

- a. An Emergency Contact List shall be located in the construction trailer and kept on file as part of the Emergency Response Plan. The list is updated on an as-needed basis when contact names and agencies may change.

13. Employee Training

- a. This site is located in a karst region. Groundwater in this topography is highly sensitive to pollution. Even though the OWNER is on "city" water, failure to follow the protective practices described above may potentially pollute wells and springs being used as water sources by folks living in rural areas. All employees will receive hands-on training in proper procedures required to comply with the BMP plan. All employees will go through a review of proper spill response techniques and general inspection

protocol. Employees will receive training when new or modified protection measures are implemented, or when new equipment/unit processes are installed that has the potential to contaminate groundwater or storm water runoff in the event of a spill.

14. Signature and Plan Review

- a. The BMP plan shall be signed by the CONTRACTOR and the OWNER and shall be kept onsite available for review.
- b. The OWNER shall make the BMP plan available upon request to the DOW Director or other authorized DOW agent.
- c. After a review by authorized DOW agent, the OWNER may be notified that the BMP plan does not meet the minimum requirements. At that point, the OWNER shall modify the BMP plan within 7 days of notification and shall submit a written certification that the requested changes have been made.
- d. BMP plans required by the KPDES permit are considered reports that shall be made available to the public, upon written request by the public, in accordance with Section 308(b) of the Clean Water Act (CWA). However, the OWNER may claim any portion of the BMP plan as confidential, in accordance with 40 CFR Part 2.

15. Plan Modification

- a. The OWNER shall modify the BMP plan when there is a change in design, construction, operation, or maintenance of the site which has a significant effect on the potential for the discharge of pollutants to waters of the Commonwealth and shall implement the changes within 7 days.

16. Modification for Ineffectiveness

- a. The OWNER shall amend the BMP plan if it proves to be ineffective in controlling the discharge of pollutants to waters of the Commonwealth and shall implement the changes within 7 days.

17. Certification Statement

"I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification."

170-18-103 (03/18)

Name (printed) : _____

Title : _____

Firm Name : _____

Address : _____

Phone Number : _____

Site Address or Description: _____

Signature : _____

Date : _____

PART 3 - EXECUTION

3.01 EXECUTION

- A. The CONTRACTOR shall implement the Storm Water Pollution Prevention Plan or Best Management Practices (BMP) Plan supplied by the ENGINEER in this Section. It shall be adjusted as needed and as stated therein for the actual site conditions. A copy of the BMP plan shall be kept on the project site. For questions regarding BMP plan implementation requirements, etc., refer to the latest edition of the Kentucky Erosion Prevention and Sediment Control Field Guide which may be obtained at the Division of Water website, www.water.ky.gov/permitting/waterwaterpermitting/KPDES;storm.
- B. The CONTRACTOR shall submit a Notice of Intent (NOI) to the **Kentucky Division of Water** at least 48 hours before any construction begins. A copy of the NOI shall be submitted to the OWNER and the ENGINEER at the same time. Construction will not be allowed to start without the copy of the NOI in the ENGINEER'S hands.
- C. All storm drains that discharge into a drainage channel, stream, lake, etc., and not onto an open field shall have an inlet sediment control device similar to the Siltsack as manufactured by ACF Environmental or Dandy Bag II by Dandy Products, or equal.
- D. Rock checks shall be used to trap sediment traveling along drainage channels, etc., straw bales are not acceptable.

170-18-103 (03/18)

- E. Any construction access road, etc., that joins any paved driveway, or road shall have a crushed stone entrance created according to the drawings and the Kentucky Erosion Prevention and Sediment Control Field Guide.
- F. Storm water runoff from undisturbed areas shall be diverted around construction sites by the use of diversion berms or diversion ditches.
- G. When silt fences and other sediment trapping devices become half full they shall be cleaned out to near new installation condition and put back into service.

END OF SECTION

SECTION 02400

STREETS, ROADS AND PARKING AREAS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment, and services required to construct access road and parking area as shown on the Contract Drawings and as specified herein.

1.02 RELATED WORK

- A. Crushed stone, DGA, paving and concrete are specified in other sections of Divisions 2 and 3.

1.03 SUBMITTALS

- A. Shop drawings, manufacturer's data and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ENGINEER in accordance with Section 00710 - Submittals.

1.04 WARRANTY

- A. Refer to Section 00710 for general warranty requirements.

PART 2 PRODUCTS

2.01 CONSTRUCTION MATERIALS

- A. Concrete materials and methods of installation are specified in Section 03300.
- B. Drainage pipe and methods of installation are specified in Section 02700.
- C. Crushed stone and dense graded aggregate materials are specified in Section 02235.
- D. Guardrail, drainage grates and other related equipment is specified in Division 5 - Metals.
- E. Geotextiles are specified in Section 02270.
- F. Bituminous paving materials and methods of placement are specified in Section 02500.
- G. Concrete paving materials and methods of placement are specified in Section 02510.
- H. Fencing materials and methods of installation are specified in Section 02830.

- I. Sodding and seeding materials and methods of construction are specified in Section 02930.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. The following items shall be performed in accordance with the latest edition of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction" except the method of payment does not apply and other exceptions are as noted below:
 1. Clearing and Grubbing
 2. Removal of Structures and Obstructions
 3. Roadway and Drainage Excavation
 4. Borrow Excavation
 5. Embankment
 6. Subgrade
 7. Chemically Stabilized Roadbed
 8. Ditching and Shouldering
 9. Embankment Drainage Blankets
 10. Final Dressing - shall be as appropriate for the type of work being performed
 11. Erosion Control - except when not within the Highway Department's right-of-way, in which case the erosion control shall follow Section 02930 of these specifications.
 12. Water Pollution Control
 13. Geotextile Construction
 14. Treatment of Open Sinkholes
 15. Settlement Platforms
- B. Drainage structures and Conduits shall be as specified in Section 03300 - Cast in Place Concrete and in Section 02700 - Sewer and Drain Pipe.
- C. Aggregate surfaces and base courses for paved surfaces shall be as specified in Section 02235 - Crushed Stone and Dense Graded Aggregate.
- D. Paved Surfaces
 1. Asphalt paving shall be as specified in Section 02500 - Asphalt Paving.
 2. Concrete paving shall be as specified in Section 02510 - Concrete Paving.

END OF SECTION

SECTION 02500
ASPHALT PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall be required to supply all materials and equipment and perform all work for the placement of the asphalt base, binder, and surface course(s), and for restoring to the preconstruction condition the surface of the streets, roads, drives and parking areas for the new access road and parking area to the depths as shown on the detailed Drawings and as specified herein.

1.02 REFERENCES

- A. Unless noted, all Specifications designations denoted KTCSSRBC refer to the Kentucky Transportation Cabinet Department of Highways Standard Specification for Road and Bridge Construction. Appropriate technical portions of the referenced sections of the Specifications shall apply, but all work and method of payment shall be as described herein unless otherwise specified or shown on the Drawings.

1.03 RELATED WORK

- A. Special sequence or schedule requirements (if any) are specified in Section 01010 - Summary of Work.
- B. Special requirements for materials and equipment are given in Section 00700 (00710) and 01600.
- C. Crushed stone surfacing requirements, temporary and permanent replacement, are specified in Section 02235 of these Specifications.
- D. New streets, roads and parking area material and construction are specified in Section 02400.

1.04 WORK DESCRIPTION

- A. Asphalt shall be used for surfacing new roads and parking areas, for replacement of drives and parking areas of asphalt construction and for resurfacing existing roads at locations shown on the Drawings or specified.

1.05 QUALIFICATIONS

- A. The pavement design mixture shall be used as determined by local plant mix availability. The design mixture shall have been approved recently by the Kentucky Transportation Cabinet Department of Highways and used recently on a state paving project.
- B. The design mix shall be submitted to the ENGINEER for review and acceptance. The submittal shall include the following:

1. The last date the mixture was approved by the Kentucky Transportation Cabinet Department of Highways for use on a state road project.
2. The location where the mixture was recently used, and the name and address of the paving contractor.

1.06 SUBMITTALS

- A. Prebid submittals, when required, are specified in Section 00820 - Special Conditions of these specifications.
- B. Shop Drawings, manufacturers data and other items needed to establish compliance with the Drawings and Specifications shall be submitted to the ENGINEER in accordance with Section 00700 (00710).

1.07 WARRANTY

- A. Refer to Section 01600 for warranty requirements.

PART 2 PRODUCTS

2.01 ASPHALT PAVING

- A. Mixture
 1. The asphaltic paving provided for use on this Contract shall conform to the applicable requirements of KTCSSRBC Section 401, Asphalt Plant Requirements; Section 402, Control and Acceptance of Asphalt Mixtures; and Section 403, Production and Placement of Asphalt Mixtures. The pavement mixture shall meet the requirements of Section 403.03.03.
- B. Fine aggregates shall meet the requirements of KTCSSRBC Section 804.
- C. Coarse aggregates shall meet the requirements of KTCSSRBC Section 805.
- D. Asphaltic materials shall meet the requirements of KTCSSRBC Section 806.
- E. Asphaltic materials for tack coat shall be one of the following: SS-1, SS-1h, CSS-1, CSS-1h, AE-60, RS-1, or CRS-1, conforming to Section 406.

2.02 FACILITIES ADJUSTMENT MATERIALS

- A. Manhole adjusting rings shall be cast iron, Neenah R-1979, J.R. Hoe, or equal. Maximum adjustment shall be 3 inches.
- B. Valve box adjusting rings shall be cast iron, Tyler Type MWW riser with 3 inches maximum adjustment.

PART 3 EXECUTION

3.01 GENERAL

- A. Construction requirements shall conform to applicable requirements of Section 403 of KTCSSRBC.

- B. A tack coat shall be required to bond new paving to the surface of concrete or brick pavements and bases or existing asphalt surfaces. It shall be applied at the rate of 0.8 pound (0.1 gallon) per square yard at the following range of application temperatures:

SS-1, SS-1h, CSS-1, CSS-1h, AE-60	70-160°F
RS-1	70-140°F
CRS-1	120-185°F

- C. When SS1, SS1h, CSS1, CSS1h, or AE60 is furnished for tack material, it shall be diluted with an equal quantity of water conforming to Section 803, shall be thoroughly mixed prior to application, and shall be applied a sufficient time in advance of the paver to ensure that all water has evaporated before the asphalt mixture is placed. The application rate shall be 0.8 pound (0.1 gallon) per square yard of the diluted SS1, SS1h, CSS1, CSS1h, or AE60.
- D. Where asphalt paving is placed against vertical surfaces such as curbs, gutters, manhole frames, valve boxes, etc., the vertical face shall be tack coated in order to seal the surface. Where these surfaces are inaccessible to pressure distributor, the tack coat may be brushed or broomed into place. The tack coat shall not be allowed to spill over onto any horizontal surface outside the area to be paved.
- E. Unless otherwise indicated on the Drawings or in these Specifications, the compacted thickness of the asphalt paving shall be a minimum of 1 inch and the minimum ambient temperature for mixing and laying temperatures shall be as follows:

Open Graded Friction Course	60°F
Asphalt Mixture (1-Inch Thick)	45°F
Asphalt Mixture (thicker than 1-inch)	40°F
Asphalt Mixture (Base and Binder)	35°F
Leveling and Wedging	45°F

- F. Trucks for hauling asphaltic mixtures shall have tight, clean, and smooth metal beds that have been sprayed with a minimum amount of soap emulsion, paraffin oil, or other approved material which is not detrimental to the mixture to prevent the mixture from adhering to the beds. All trucks shall be equipped with covers of sufficient size to completely cover the loaded material, and all covers shall be securely fastened in place before the truck leaves the plant. Truck beds shall be insulated, when necessary, to maintain the specified temperature to the point of delivery. Any truck causing excessive segregation of material by its spring suspension or other contributing factors, shall be discharged from the work, until such conditions are corrected.
- G. The CONTRACTOR shall have an accurate thermometer on the job at all times for verifying all temperature requirements and for taking temperature measurements whenever requested by the ENGINEER or OWNER. The CONTRACTOR shall closely control temperature and compaction requirements in order to achieve quality asphalt paving and related work.

- H. Asphalt paving which fails as the result of not meeting the requirements of these Specifications shall be removed and replaced as directed by the ENGINEER at the CONTRACTOR'S expense.
- I. Where manhole frames, valve boxes, drainage grates, etc., are located within the area to receive asphalt paving replacement, those facilities shall be adjusted to final pavement grade prior to the placement of the asphalt surface. Where the facilities to be adjusted are the property of the OWNER, the CONTRACTOR shall adjust the facilities with the cost included in the CONTRACTOR'S bid for asphalt replacement. Where the facilities to be adjusted are the property of other utility companies, i.e., gas, water, electric, telephone, the CONTRACTOR shall notify each utility company of the schedule for repaving of the particular area to allow those companies sufficient time to adjust their facilities prior to beginning the repaving process.
- J. Where pavement striping is destroyed or damaged, it shall be replaced per the requirements stated herein. The cost of all striping, unless stated otherwise in these specifications, shall be included in the price bid for pavement replacement.
- K. Damaged or destroyed traffic control loops shall be replaced per the requirements of the traffic control operator with the cost incorporated into the CONTRACTOR'S bid for pavement replacement.

3.02 PAVING OF NEW STREETS, ROADS AND PARKING AREAS

- A. The placement of asphalt paving for new streets, roads and parking areas shall meet the requirements of KTCSSRBC - Section 403.

3.03 FULL WIDTH PAVING OF EXISTING STREETS, ROADS AND PARKING AREAS

- A. Where the entire width of the existing asphalt paved street damaged by construction is to be resurfaced, the existing pavement shall be cleaned and tack coated, and asphalt paving shall be hot applied as previously described in Article 3.02 herein.
- B. The preparation of the base shall include removal of unstable material from the disturbed areas, removal of excess crushed rock from the trench to same level as the existing asphalt pavement and addition of compacted crushed rock (DGA) to the trench or where needed. No cutting of edges of existing paving will be required.
- C. The ENGINEER will determine if and where leveling courses are required before application of surface courses. The leveling course shall be hot applied and rolled similarly to the surface course.
- D. The surface course shall be 2 inches thick applied to the entire width of the street, unless otherwise directed by the ENGINEER. The surface course shall be feathered out to a thickness of 1 inch at the front of existing gutters. The point where feathering shall begin and the amount of feathering shall be controlled by the ENGINEER. Where there are no gutters, feathering of edges will not be done unless otherwise directed by the ENGINEER in order to conform to existing features, such as driveways.

- E. Payment for the surface course shall be by the linear feet of full width pavement replaced.
- F. No extra payment will be allowed for tack coat, removal of unstable material, compacted dense graded aggregate (DGA) used to replace unstable material, removal of excess crushed rock from the trench to the grade of existing pavement, and cleaning of the surface.

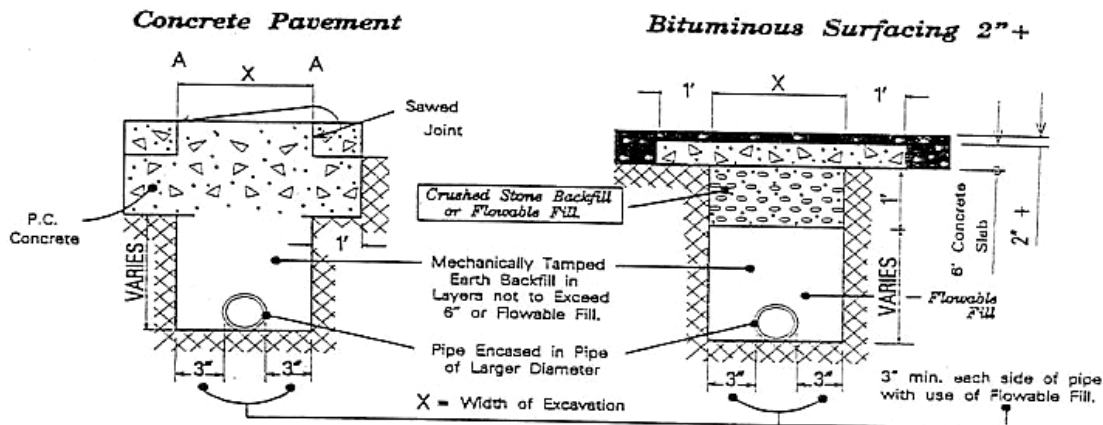
3.04 TRENCH WIDTH REPAVING - CITY AND COUNTY STREETS, ROADS AND PARKING AREAS

- A. The cut edges of the existing paving surface shall be trimmed a depth of at least 2 inches to straight lines for uniform appearance and clean surface at joints. The area between the cut edges of the paving shall be removed to a depth of 2 inches (minimum) or to the bottom of the existing paving. All unstable material in the trench shall be removed and replaced with compacted dense graded aggregate and dense graded aggregate added as needed to bring the base surface to the bottom of existing paving or 2 inches below the existing surface, whichever is the lower. Dense graded aggregate required for stabilizing the subgrade will be paid for as an extra, but no extra payment will be allowed for removal of unstable back-fill.
- B. The paving subgrade shall be compacted under the wheel of a roller, until there is no observed settlement of the subgrade.
- C. The sides of existing pavement shall be covered with a tack coat and asphalt paving shall be hot applied as previously described. Final surface shall be finished to 1/4-inch above existing paving surface at edges and crowned to 1/2-inch above existing surface at the center.
- D. Payment for asphalt repaving shall be per linear foot of pipeline covered to any width the CONTRACTOR shall find necessary to remove plus width of cut back to secure clean straight edges, and shall include excavation to subgrade, preparation of subgrade, cleaning edges of existing paving, tack coat, and all operations and materials planned and specified for this type of repaving. The CONTRACTOR shall maintain such repaving up to grade of existing street surface until final completion and acceptance of work under his Contract. During the guarantee period of one year, the CONTRACTOR will be responsible for defective materials or workmanship, and natural settlement.
- E. In case additional asphalt paving is to be added due to settlement, the surface which has experienced settlement shall be cut out, additional dense graded aggregate added if necessary, tack coat applied to the existing sides of existing pavement, and the paving in the settled area(s) replaced. Additional payment will not be allowed for the repair work required.

END OF SECTION

Attachment: Kentucky Department of Highways drawing No. TC 99-13.

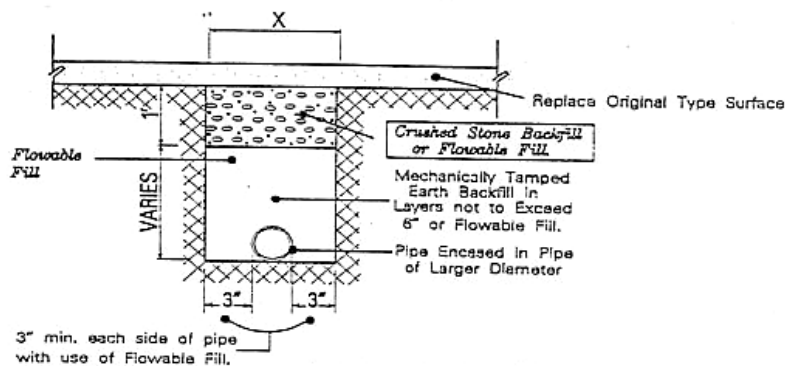
SURFACE RESTORATION METHODS



Replace Concrete Pavement
with new pavement same
thickness of existing pavement.

Replace Bituminous Pavement with same type and depth as existing pavement.

Bituminous Surface Less Than 2" & Traffic Bound Macadam



NOTE:

1. Distance From points "A" (Concrete Pavement) to nearest joint or break in pavement must be six (6) feet or more. If less than six (6) feet, remove pavement to joint or break and replace entire slab.
2. Concrete slab under Bituminous Surface to extend twelve (12) inches on each side of trench.
3. An approved joint sealer to be applied between new and existing pavement.

KENTUCKY TRANSPORTATION CABINET

Department of Highways

Methods of Surface Restoration Due to Open trench Pipe Installation

SECTION 02510
CONCRETE PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to construct concrete sidewalks as shown on the Contract Drawings and as specified herein.

1.02 RELATED WORK

- A. Special sequence or schedule requirements (if any) are specified in Section 01010 - Summary of Work.
- B. Special requirements for materials and equipment are given in Sections 00700 (00710) and 01600.
- C. Grading and drainage of streets, roads and parking areas are as specified in Section 02400.
- D. Crushed stone bases, if required, are as specified in Section 02235.
- E. Concrete drainage structures are specified in Sections 03300 and 03400.
- F. Castings are specified in Section 05540.

1.03 SUBMITTALS

- A. Prebid submittals, if required, are specified in Section 00820 - Special Conditions.
- B. Shop drawings and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ENGINEER in accordance with Section 00700 (00710).

1.04 WARRANTY

- A. Refer to Section 00700 (00710) for warranty requirements.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Concrete and related materials are specified in Section 03300.

PART 3 EXECUTION

3.01 CONCRETE SIDEWALKS AND STEPS

- A. New Construction
 - 1. Concrete sidewalks and steps shall be dimensioned and reinforced as shown on the Drawings.

2. Sidewalks and steps shall be constructed on a prepared, compacted, smooth subgrade of uniform density formed by trenching or filling to the required elevation. Large boulders and ledge rock found in the subgrade shall be removed to a minimum depth of 6 inches below the subgrade elevation and the space shall be backfilled with suitable material which shall be thoroughly compacted by rolling or tamping. A 3-inch thick course of No. 9 coarse aggregate shall be placed on prepared subgrade prior to placing concrete walks. The CONTRACTOR shall furnish a template and shall check the finished subgrade prior to depositing concrete. The subgrade shall be moistened immediately prior to placement of concrete. Sidewalks may be placed by use of side forms or by use of an acceptable slip-form method.
3. All exposed edges and corners for sidewalks and steps shall be rounded to a 1/4-inch radius.
4. The surfaces of sidewalks shall be divided into rectangular areas by means of a jointer having a radius of 1/4-inch and forming a groove no less than 1 inch in depth for the full width of the walk, or the joints may be sawed if acceptable to the ENGINEER. The length of the rectangles formed shall not exceed the width of the sidewalk being constructed, unless otherwise directed.
5. The CONTRACTOR shall install 1/2-inch premolded expansion joints, specified in Section 03300, extending entirely through the sidewalk at intervals not to exceed 40 feet, unless the sidewalk is constructed integral with the curb, in which case the width of joints and spacing shall conform to that in the curb, or as otherwise directed. The edges of the sidewalk at all expansion joints shall be rounded with an acceptable edging tool to a 1/4-inch radius. One-half inch premolded expansion joint material shall be installed to the full depth of the sidewalk where the walk abuts any rigid structure or fixture such as curbs, columns, castings, buildings, light standard, etc.

B. Replacement Construction

1. Replacement construction shall be the same as required above for new construction except as hereinafter set forth.
2. Sidewalks shall be replaced to the same width, grade and thickness (3-1/2 inches minimum) as the original sidewalk, unless otherwise directed by the ENGINEER. In replacing concrete walks against edge of existing walks, the existing edges shall be sawed to straight edges and thoroughly cleaned. The new and existing walks shall be separated by 1/2-inch premolded expansion joint material cemented to the existing walk.
3. Concrete curb and gutter shall be protected by the CONTRACTOR and shall not be removed except in the event of solid rock excavation and/or conflict with existing utilities. Grass strips between sidewalks and curbs shall be reseeded in accordance with Section 02930 of these Specifications.

4. For unit price contracts, sidewalk replacement, including reinforcing and forms, will be paid for by the linear foot measured along the centerline of pipe so covered. The unit price bid shall include excavation to subgrade; preparation of subgrade; required base course, if any, as shown on the Drawings; expansion joints; marking and reseeding of grass strips when required; and replacing concrete to any width which the CONTRACTOR should find necessary to remove.
5. At the unit price bid for sidewalk replacement for unit price contracts, the CONTRACTOR will not be required to replace greater than 4 foot width, 4 inches thick. However, where a 4 foot or less width walk is cut longitudinally, the whole walk shall be replaced. If replacement over 4 foot width is required, the unit price per linear foot shall be increased, the increased width's proportion to 4 feet.

END OF SECTION

SECTION 02700
SEWER AND DRAIN PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. All pipe and accessories supplied for use on this project shall be as specified herein.
- B. All pipe supplied for this Project shall be of the pipe material called for on the Drawings.

1.02 RELATED WORK

- A. For cover pipe and boring and/or jacking see Section 02326.

1.03 REFERENCES

- A. Where referenced specifications (ASTM, AWWA, etc.), are mentioned, these standards are deemed to be the minimum standard of quality of materials or methods to apply to this project.

1.04 SUBMITTALS

- A. Copies of the manufacturer's directions for handling and installing the particular pipe supplied and accepted by the ENGINEER shall be furnished to the ENGINEER at the first delivery of pipe to the project in numbers that will permit the ENGINEER to retain three copies.
- B. The manufacturer's instructions shall be strictly followed unless a conflict exists between the manufacturer's instructions and those contained herein. In such cases, the ENGINEER shall determine which methods are to be followed and no pipe shall be installed until the CONTRACTOR has received written instruction from the ENGINEER as to which procedure to follow.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. All pipe, fittings and jointing materials shall be of one manufacturer unless different types are shown on the Drawings or otherwise accepted by the ENGINEER.

2.02 MATERIALS - DRAIN PIPE

- A. Reinforced Concrete Drain Pipe

- 1. Pipe

- a. Reinforced concrete drain pipe shall comply with ASTM Designation C 76. Pipe shall conform to standard strength

classification, Classes II, III, IV and V for wall "B" design per ASTM C 76. The coarse aggregate shall be crushed limestone only. The pipe shall be bell and spigot configuration.

- b. The basis for acceptance of the reinforced concrete pipe for use on this Project shall be as stated in ASTM C 76, paragraph 5.1.2.
- c. Pipe dimensions, wall thickness, variations of dimensions, finish, repairs, rejection and marking shall be per paragraphs 11 through 13 and tables 1 through 5 of ASTM C 76.

2. Fittings

- a. Tee branches shall be furnished with the connection or connections of the size or sizes specified, securely and completely fastened in the process of the manufacture to the barrel of the pipes. Tee branches shall have their axis perpendicular to the longitudinal axis of the pipe. All branches shall terminate in sockets and the barrel of the branch shall be of sufficient length to permit making a proper joint where connecting pie is inserted in the branch socket.

3. Joints

- a. The material used for sealing the joints of reinforced concrete pipe shall be asphalt mastic compound meeting the requirements of Section 807.02.04 of the Kentucky Transportation Cabinet Department of Highways Specifications for Road and Bridge Construction. The sealing material shall be a smooth, uniform mixture of asphalt cement, solvent and mineral filler. The mineral filler shall consist essentially of cellulose fiber. The compound shall be applied by trowel or caulking gun without pulling or drawing and shall not sag or flow when applied to the surface.
- b. The compound shall be capable of withstanding freezing and shall not exhibit a tendency to separate or deteriorate while in storage. When cured, the compound shall set to a tough, plastic coating without shrinking, cracking or loosening from the surface.
- c. In addition, the material shall comply with the test conditions and requirements of the following table:

TABLE 1.01

	<u>Min.</u>	<u>Max.</u>
Grease Cone Penetration (ASTM D 217, Unworked, 150 gm, 77°F, 5 Sec.) 0.10mm	175	250
Weight per Gallons, Lbs.	9.75	-
Non-Volatile (10 gm, 221°F - 230°F, 24 hrs.), percent	75	-
Ash (by ignition), percent	25	45

- d. The CONTRACTOR shall submit sufficient copies of literature of the sealing material proposed for use for the ENGINEER'S review and acceptance to permit the ENGINEER to retain 3 copies.

B. Corrugated Steel Drain Pipe

1. Pipe

- a. Galvanized corrugated steel pipe shall be of the gauge and of the sizes shown on the Drawings. Corrugations may be of annular or helical configuration. Helical corrugations may be welded seam or lock seam. Corrugations shall have a pitch of 2-2/3 inches and a depth of 1/2-inch (tolerance for each shall be 1/8-inch).
- b. Corrugated steel circular pipe shall meet the requirements of the American Association of State Highway and Transportation Officials (AASHTO) M-36, Type I. Corrugated steel pipe arch shall meet the requirements of AASHTO M-36, Type II.

2. Fittings

- a. Galvanized corrugated steel fittings for use with corrugated steel pipe shall be of the same gauge as the pipe and of the same manufacturer as the pipe. Fittings shall be fabricated by the pipe manufacturer and be of the type and configuration as accepted by the ENGINEER.

3. Joints

- a. Joints for corrugated steel pipe shall be coupling bands of the same manufacturer as the pipe. Coupling bands shall be galvanized and approximately 5 corrugations in width. Coupling bands shall be connected at the ends by galvanized angles and retained by at least 2 galvanized bolts not less than 1/2-inch in diameter. Coupling bands shall be the same gauge as the pipe.

4. Coating

- a. When shown on the Drawings or called for in these Specifications, corrugated steel pipe, fittings and couplings shall be asphalt coated. Asphalt coating material and methods of application shall meet the criteria as established in AASHTO M-190.

C. Underdrain Pipe

1. Pipe

- a. Underdrain pipe and fittings shall be of the sizes, with and without perforations, as indicated on the Drawings.
- b. Pipe shall be polyvinyl chloride (PVC) pipe, Type S, as follows:
 - (1) Smooth—Conform to ASTM D 1785 for Schedule 40, or ASTM D 2241 for SDR-17.
 - (2) Ribbed—Conform to ASTM F 794 for Series 46.
 - (3) Corrugated—Conform to ASTM F949.
- c. Manufacturer shall certify to ASTM requirements.

2. Fittings and Couplings

- a. Couplings for perforated pipe shall be the flexible plastic type and couplings for unperforated pipe shall be watertight, standard couplings with solid rubber rings. All fittings and couplings shall be as recommended by pipe manufacturer.

PART 3 EXECUTION

3.01 TRENCH EXCAVATION - DRAIN PIPE

A. General

- 1. All excavation shall be open trenches, except where the Drawings call for tunneling, boring or jacking under structures, railroads, sidewalks, roads or highways.

B. Trees and Shrubs

- 1. Trenching shall include all clearing and grubbing, including all weeds, briars, trees and stumps encountered in the trenching, regardless of size. The CONTRACTOR shall dispose of any such material by burning, burial or hauling away or as noted on the Drawings, at no extra cost to the OWNER. Ornamental shrubs, hedges and small trees (3 inches in diameter or less) shall be removed, protected and replanted, at no extra cost to the OWNER.
- 2. Where pipelines run through wooded terrain, cutting of trees within limits of maximum permissible trench widths, as set forth in this article, will be

permitted. However, cutting of additional trees on sides of trench to accommodate operating of trenching machine will not be permitted. The CONTRACTOR shall obtain specific permission of the OWNER before cutting any tree larger than 4 inches in diameter.

C. Highways, Streets and Railroads

1. Trenching also includes such items as railroad, street, road, sidewalk, pipe, small creek crossings, cutting, moving or repairing damage to fences, poles or gates and other surface structures, regardless of whether shown on the Drawings.
2. The CONTRACTOR shall so coordinate his work as to produce a minimum of interference with normal traffic on highways and streets. He may, with the approval of the governing agency, close a street to traffic for such length of time considered necessary, provided persons occupying property abutting the street have an alternate route of access to the property which is suitable for their needs during the time of closure. It shall be the responsibility of the CONTRACTOR to give 24 hours advance notice to fire and police departments and to occupants of a street which will be closed, in a manner approved by the governing body.
3. Where located within city streets and/or roads, the opening of more than 200 feet of trench ahead of pipe laying and more than 100 feet of open ditch left behind pipe laying, before backfilling, will not be permitted, except upon written consent of the OWNER. Where located outside roadway or parking areas, longer distances for opening and closure may be allowed provided the longer distance does not affect the safety of the general public. No trench shall be left open or work stopped on same for a considerable length of time. In case of objectionable delay trench shall be refilled according to backfill specifications.
4. Construction equipment will not be approved for use where treads are injurious to paving encountered. Curbs, sidewalks, and other structures shall be protected by the CONTRACTOR from damage by his construction equipment.
5. In case of damage to any existing structures, repair and restoration shall be made at once and backfill shall not be replaced until this is done. In all cases, restoration and repair shall be such that the damaged structure will be in as good condition and serve its purpose as completely as before, and such restoration and repair shall be done without extra charge, except as set forth under the applicable provisions of the General Conditions.
6. Where trenching is cut through paving which does not crumble on the edges, trench edge shall be cut to at least 2 inches deep to straight and neat edges, before excavation is started, and care taken to preserve the edge to facilitate neat repaving.

7. The CONTRACTOR shall maintain road crossings in a passable condition for traffic until the final acceptance of the work, being paid only by unit price for crushed rock used, within limitations as hereinafter specified.
8. Railroad company and Department of Highways requirements in regard to trenching, tunneling, boring and jacking shall take precedence over the foregoing general specifications and the following tunneling and boring or jacking specifications, where they are involved. Where work is within railroad right-of-way, Railroad Protective Insurance shall be carried by the CONTRACTOR in the amounts required by the Railroad Company.
9. The insurance policy shall name the railroad as the insured and the original policy shall be delivered to the railroad after submitting same to the OWNER for review. The cost of flagmen required by the railroad and/or highway departments shall be paid by the CONTRACTOR.

D. Existing Utilities

1. The CONTRACTOR shall determine, as far as possible in advance, the location of all existing sewer, culvert, drain, water, electric, telephone conduits, gas pipes, and other subsurface structures and avoid disturbing same in opening his trenches. In case of sewer, water and gas services and other facilities easily damaged by machine trenching, same shall be uncovered without damage ahead of trenching machine and left intact or removed without permanent damage ahead of trenching and restored immediately after machine has passed, without extra cost to the OWNER. The CONTRACTOR shall protect such existing facilities, including power and telephone poles and guy wires, against danger or damage while pipeline is being constructed and backfilled, or from damage due to settlement of his backfill. It shall be the responsibility of the CONTRACTOR to inform the customers of utilities of disruption of any utility service as soon as it is known that it has been or will be cut off.
2. Where there is the possibility of damage to existing utility lines by trenching machine, the CONTRACTOR shall make hand search excavation ahead of machine trenching, to uncover same, at no extra cost to the OWNER. Hand trenching is required, at no extra payment, where undue damage would be caused to existing structures and utilities by machine trenching.
3. The work of uncovering and backfilling required for locating existing sewers, water lines and other existing facilities for connection of improvements or avoidance in location of proposed pipeline, where such uncovering and backfilling is not within trench for improvements, shall be paid for at a price per cubic yard for such excavation actually removed and backfilled under item for "Search or Extra Depth Trench Excavation." Such payment does not include uncovering existing utility lines for their protection during or after trenching operations for the proposed pipeline.

E. Pipelines in Same Trench

1. Pipelines, force mains, and sewers laid in same trench shall, in all cases, be bedded on original earth, crushed stone, or other specified bedding materials, regardless of divergence in their elevations, unless otherwise specified. They shall never be laid in unsupporting backfill or one above the other. The CONTRACTOR shall receive applicable unit prices for each pipeline, force main, and sewer so laid, the same as if laid in widely separated trenches.

F. Location of Proposed Pipelines

1. The location of pipelines and their appurtenances, as shown on the Drawings, are those intended for the final construction. However, conditions may present themselves before construction on any line is started that would indicate desirable changes in location. Also, development of property traversed may require location changes. In such cases, the OWNER reserves the right to make reasonable changes in line and structure locations without extra cost, except as may be determined by the application of the unit prices bid to the quantities actually involved. The OWNER is under no obligation to locate pipelines so they can be excavated by machine.

G. Construction Stake-out

1. The ENGINEER will provide geometric base data for the CONTRACTOR'S use in locating sewers and facilities in the design location. The locations for vertical control (benchmarks) are shown on the Drawings with elevation and description duly noted. Each manhole, pumping station wetwell, or other notable sewage system component shall have the coordinates shown at the individual location or listed with the General Notes of the Drawings. It shall be the CONTRACTOR'S responsibility to locate the new facilities in their intended position using survey grade GPS survey equipment. It should also be the CONTRACTOR'S responsibility to provide offset hubs at each manhole or such reference points as may be required to maintain the location of each new installation.
2. Where the CONTRACTOR elects to use grades (batter) boards for sewer construction, offset line and grade stakes shall be set and cut sheets prepared before trenching work is started. All stake-out work and cut sheet preparation shall be accomplished by the CONTRACTOR, the ENGINEER being responsible for review and checking the finished cut sheets. The CONTRACTOR shall provide all material, equipment, and labor for all stake-out work. Cut sheets, where required, shall be prepared on forms supplied by the ENGINEER (HKB Form RPR-4).
3. The cut sheets shall contain the following minimum information:
 - a. Manhole stations
 - b. Grade between manholes

- c. Centerline and offset stations
 - d. Amount and direction of offset
 - e. Centerline elevation
 - f. Centerline cut
 - g. Offset elevation
 - h. Offset cut
 - i. Average trench depth
 - j. Utilities information and depths and/or any other pertinent information.
4. Where the CONTRACTOR elects to use grade (batter) boards for sewer construction, offset hubs shall be set perpendicular to each 25 foot centerline station. Where laser beam equipment is to be used, the offset line shall be as required for the specific type of laser equipment used. In either case, the CONTRACTOR shall be required to maintain at least the offsets at manholes until the sewer main has been constructed. The CONTRACTOR shall also, in either case, be required to obtain the original ground elevation along centerline, at each 25 foot station, for the purpose of calculation of the average trench depth.
5. Grades shown on the Drawings or as revised in the field are invert of pipe and NOT trench subgrade. The centerline cuts on the cut sheets shall have this calculation made, original ground surface to invert of sewer pipe, which is the depth which shall be used for calculation of the average depth of trench and backfill.

H. Trench Requirements

- 1. All trenches must be dug neatly to lines and grades as shown on the Drawings, as established in the field and/or as established on the cut sheets. Trenches shall be of sufficient width to properly assemble or bolt joints.
- 2. Trenching shall be completed between one grade control point and the next in advance of the laying of pipe, where pipes, culverts, or other structures may be encountered whose grade cannot reasonably be determined ahead of trenching. Should the CONTRACTOR lay pipe closer to the opening of trench ahead, he shall bear cost of any removal and relaying which may be required to avoid location conflict.
- 3. The extra cost of trenching in difficult locations, such as stream, railroad or highway crossing, if not covered by other Contract unit prices, shall be included in the unit price for furnishing, laying, trenching and backfilling.

4. Where grade (batter) boards are used to establish finish grade, they shall be set by the CONTRACTOR, with at least 3 boards set at all times where installation is in progress. These will be set each 25 feet or less and will be set perpendicular to and spanning the centerline of the trench, such that the grade string is in the vertical plane of the pipe flow line. Grade boards shall be supported by stakes driven firmly on each side of the trench, unless otherwise acceptable to the ENGINEER. Where laser beam equipment is used, the setup shall be per the laser manufacturer's instructions and/or the permission of the ENGINEER.
5. Grades shown on the Drawings and/or profiles, cut sheets and offset stakes are the elevations of the invert of the pipe in all cases and excavation in open trench or tunnel must be made of sufficient depth to take care of required bedding of pipe and bells below these lines.
6. No additional compensation will be allowed for the extra depth trenching so required below invert.
7. Where bottoms of trench for 6-inch through 16-inch size pipe are in or on solid rock or where concrete cradle or arch is to be used, trenches or tunnels shall be dug to a depth of at least 6 inches below bottom of barrel of pipe. Where in earth, they shall be dug to at least 4 inches below bottoms of pipe barrels and bells.
8. In pipe sizes 18-inch through 72-inch, the trench shall be dug to a depth of 1/4 of the outside diameter of the pipe below the bottom of the pipe barrel in earth or solid rock subgrade, with a maximum of 9 inches, and a minimum of 6 inches. This requirement shall also apply where concrete arch or cradle is used to protect the pipe.
9. When trench or tunnel is dug below required grade, the pipe must be brought to grade by filling with crushed rock for pipe bedding as specified in this Section 02700 of these Specifications, at the CONTRACTOR'S expense. Fill for pipe support shall not be made with material excavated from trench.

I. Excavation Unclassified

1. Excavation for pipelines shall be unclassified and the cost of all excavation of whatever nature and state, including solid rock, shall be included in the CONTRACTOR'S unit price bid for furnishing, trenching, laying and backfilling the pipe.
2. Excavation for structures such as manholes, pump stations, and vaults is likewise unclassified and the cost of all excavation of whatever nature and state, including solid rock, shall be included in the CONTRACTOR'S lump sum or unit price bid, as the case may be.
3. Solid rock is defined as materials of one-third cubic yard or more in one location (in a native state or concrete) that rings under the hammer which

cannot be removed economically without the use of explosives. Paving removal is excluded; also shale rock.

4. In the event the ENGINEER finds it necessary to specifically order mechanical removal of solid rock, it will be measured by the cubic yard for such materials actually removed limited in depth to required depths of bedding below outside of pipe barrel and in width to the following dimensions:

TABLE 3.01

For 6" Pipe 2'-6"	For 15" Pipe 2'-10"
For 8" Pipe 2'-9"	For 16" Pipe 2'-11"
For 10" Pipe 2'-9"	For 18" Pipe 3'-2"
For 12" Pipe 2'-9"	For 20" Pipe 3'-5"
For 14" Pipe 2'-9"	For 21" Pipe 3'-6"
	For 24" Pipe 3'-8"

5. Mechanical removal of solid rock is defined as solid rock in its native state which is ordered to be fractured and broken up for removal by hand tools and/or hand held power or pneumatic tools to provide protection of utilities, structures, etc. which might otherwise be subject to damage by conventional drilling and shooting or heavy excavating equipment.
6. Payment for mechanical removal will not be authorized for solid rock excavation which is accomplished by drilling and shooting or by crawler or wheel mounted excavators, trenching machine, and similar equipment.

J. Dewatering of Trenches

1. Dewatering of trenches shall be considered a part of trenching, at no extra cost to the OWNER. Dewatering of trenches shall include ground-water and storm or sanitary sewage. Suitable pumping and other dewatering equipment is to be provided by the CONTRACTOR, to insure the installation of the pipeline structure in a dewatered trench and under the proper conditions. Dewatering shall include all practical means available for prevention of surface runoff into trenches and scouring against newly laid pipe.
2. Piles of excavated materials shall be trenched or temporarily piped to prevent, as far as practical, blockage of drainage ditches and gutters, and water carriage of excavated materials over street and highway surfaces.

3. Where subgrade of trench has insufficient stability to support the pipeline and hold it to its original grade, the ENGINEER may order stabilization by various means. Exclusive of dewatering normally required for construction and instability caused by neglect of the CONTRACTOR, it shall be paid for at unit prices set up in the Contract, such as extra excavation, crushed rock for pipe bedding, concrete cradle or piling.

3.02 LAYING SEWER PIPE

A. General

1. Checking of Pipe
 - a. The selection of pipe strength class shall be based on earth weight of 130 pounds per cubic foot and a safety factory of 1.50.
 - b. All pipe and fittings must be tested for uniform diameter, straightness and defects by the CONTRACTOR before being lowered into trench, and rejected pipe marked in a way not to impair its value. Rejected pipe must be separated from accepted pipe and removed from the project. The ENGINEER will make periodic observations of pipe in storage and/or incorporated into the work. Pipe found defective, not meeting Specifications, or improperly installed shall be rejected and replaced.
2. Alignment and Grade
 - a. All pipe, after being inspected and accepted, shall be laid to correspond with lines and grades staked out by the CONTRACTOR. All sewer lines shall be laid to constant grades between invert elevations shown on the Drawings. Grades shown on the Drawings are invert of pipe and NOT trench subgrade. The pipe lengths shall be fitted together and matched, so that they will form a sewer with a smooth and uniform invert, visible as a full circle from manhole to manhole, except in special cases where curved sewer lines are planned.
3. Unstable Subgrade
 - a. In wet, yielding, and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. If crushed rock fill is necessary, it will be paid for per ton of such material used, except in cases where instability is caused by neglect of the CONTRACTOR.

4. Control of Quantities Laid

- a. Laying of pipe may be held up by the ENGINEER until trench has progressed far enough ahead to remove the possibility of having to change grade or alignment on account of other structures, pipelines or conduits.
- b. Unless permitted or directed, not less than 100 feet of pipe shall be laid at one operation except for the following reasons:
 - (1) Street and railroad crossings.
 - (2) Wet caving trenches.
 - (3) Business houses or institutions damaged by prolonged disconnection from street.
 - (4) Less than 100 feet distance between manholes or pipe control sections.

5. Bedding of Pipe

- a. Six inch through 16 inch pipe shall be laid with bottom quadrant of barrel and bells of pipe bedded in at least 4-inch depth of crushed stone when on earth subgrade and in at least 6-inch depth of crushed stone, below the bottom of the barrel of pipe when on solid rock subgrade. Stone for bedding of 6 inch through 16-inch pipe shall be Kentucky Department of Highways Size 9 crushed rock as specified in Section 02235 of these Specifications, spaded into place. It shall be included in price for furnishing and laying pipe. Payment for the extra stone required for bedding pipe in solid rock for 6-inch through 16-inch pipe shall be included in the price bid for solid rock excavation in the case of classified excavation and in the price bid for trenching and backfilling in the case of unclassified excavation.
- b. In case of pipe sizes 18-inch through 72-inch in both earth and solid rock trench, the subgrade shall be shaped to provide for a crushed stone pad, Kentucky Department of Highways Size 9, for a depth under the pipe barrel at least $\frac{1}{4}$ the outside diameter of the pipe, with a minimum of 6-inch depth and a maximum of 9-inch depth. The bedding material shall be thoroughly spaded into place, in order to give a uniform bearing for at least the bottom quadrant of the pipe. Payment for such bedding shall be included in the price paid for trenching and backfilling or laying, even when in or on solid rock.
- c. For PVC or polyethylene pipe, alternate bedding materials will be allowed with permission of the ENGINEER. In order to qualify for use with sewer pipes of these compositions, the bedding material must be of the type of material delineated as Class IA embedment

materials per Table 1 of ASTM D 2321, namely, coral, slag, cinders, crushed stone or crushed shells. The alternate bedding materials must also be of the same gradation of the crushed stone previously specified, namely, Kentucky Department of Highways Size 9. The crushed stone previously specified shall be used for all other piping materials.

- d. No filling of trench with earth to bring pipe to grade will be permitted. If trenches are dug too deep, they must be brought to grade and supported by crushed rock for pipe bedding (No. 9) as specified in Section 02235 of these Specifications at the CONTRACTOR'S expense. No pipe shall be laid in the trench until the subgrade is inspected and found correct.

6. Laying of Pipe (Mains)

- a. Laying crew foreman shall direct subgrade preparation and plumbing and leveling invert of pipe to grade and line, the pipe layer following his directions in placing the pipe. The pipe layer will be responsible for pipe bedding, cleaning joint, proper placement of joint annular ring or gasket, tight jointing and homing pipe, securing pipe against settlement or other movement, and inspecting and swabbing out any jointing material from inside of pipe.
- b. No joints will be accepted that show leakage and, after backfilling and inspection, any joints are found that are allowing groundwater to enter the sewer must be excavated and repaired.
- c. Plugs in branch fittings to future building sewers shall be protected from excavators by the method as shown on the Drawings for protecting the ends of laterals and shall be so constructed and joined in bell of pipe that they will be watertight, yet removable without breaking the bell or coupling when removed.

7. Laying of Branch Pipes and Laterals

- a. Branch pipes shall be laid to serve the abutting property at points to be designated by the ENGINEER. Such pipes shall be connected to sewer main through tees or Y-branches of size of running sewer barrel and 6-inch side opening, with 6-inch 30 degree or 45 degree bends. Branch fittings in sewer and the connected bend, shall be supported from bottom of trench per standard details shown on Drawings.
- b. At locations where the sewer is within street or road rights-of-way, house lateral pipes shall be laid to the property line or right-of-way line.

- c. At locations where the sewer is within easement obtained by the OWNER, house lateral pipes shall be laid to the permanent easement line.
 - d. Branch tees or wyes for house laterals will be located during construction, regardless of where shown on the Drawings. House lateral location shall be at the convenience of the property owner or as directed by the OWNER and/or ENGINEER.
 - e. The end openings of house laterals shall be plugged with appropriate watertight plugs of permanent materials in the bell of the sewer lateral, removable without breakage of the pipe bell. Dead ends of sewers shall be plugged similarly.
 - f. Under normal conditions, where elevations are not critical, branch service sewers to customers shall be laid on not less than .01 foot per foot of length grade. Where elevations are critical, minimum grade shall be .005 foot per foot laid with batter boards or laser, same as specified for street sewers.
 - g. In the case of deep sewers, branch pipes may be brought up to a depth of approximately 5 feet below ground level with suitable bends and sewer pipe. These pipes shall be laid on a slant outside sewer trench, so they will be supported on original earth and not dragged down and cracked by backfill settlement.
 - h. In case of deep sewers in rock or narrow places, branch pipes shall be of cast iron soil pipe installed vertically per standard details of Drawings, with branch fittings in sewer main encased in Class 2,500 concrete. Payment for such concrete and forms above wye or tee branch shall be at the price bid per encasement.
 - i. All lateral sewers and branch pipes installed on this Contract shall have a detectable mylar tape placed in the backfill over and running with the lateral sewer. The tape shall be readily detectable employing the same type metal locators as used for the location of metal pipelines. The tape shall be bright orange in color and have the words, "Caution, Sewer Line Below" printed on it. The tape shall be installed as shown on the standard details of the Drawings.
 - j. The tape shall be Type II, Detectable Mylar Marking Tape as manufactured by Line Guard, Inc. or equal. The cost of purchase and placement of the marking tape shall be included in the CONTRACTOR'S unit price bid for the lateral pipe and fittings.
8. Piping Connections at Structures
- a. Lines
 - (1) Pipes shall be laid free from all structures other than manholes. Any pipe entering structures underground

unsupported by original earth shall be supported by Class 2500 concrete, brick and mortar masonry, or Class 4000 concrete beams and columns as shown on detailed Drawings.

- (2) Pipe shall be connected to manholes by fabricated manhole entry seals, specified in Section 03480 of these Specifications.
- (3) Pipe stubbed out of manholes for future connections shall be plugged and tightly sealed with same jointing material used to plug laterals.

b. Plants

- (1) Nonpressure pipes entering structures underground, unsupported by original earth for a distance of more than 3 feet shall be supported by Class 2500 concrete, where depth of such support does not exceed 3 feet. All pipes entering buildings or basins below original ground, which are more than 3 feet above structure subgrade and/or have a 3-foot span between wall and original earth, and have cover of more than 24 inches of earth or under roadway, shall be supported by concrete beams under them as shown on the Drawings with columns each 6 feet between structural wall and edge of excavation for the structure in order to prevent breakage from settlement of backfill about the structure. Concrete and reinforcing steel for such support are to be included in the lump sum portion of the Contract and not as extra concrete. Sewers entering structures shall have flexible joint within 16 inches of exterior of structure.

9. Installing Sewer Pipe in Cover Pipe

- a. The installation of sewer pipe inside steel cover pipe is detailed in Section 02326 of these Specifications.

10. Protection of Pipe in Trench

- a. No walking upon the completed pipelines will be permitted until trench has been backfilled to a depth of at least 6 inches over the top of the pipe. The interior of the pipe shall, as the work progresses, be cleaned of all dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a suitable plug fitted into the pipe bell, so as to exclude earth and other material, precautions being taken to prevent flotation of pipe by runoff into trench.

11. Observation of Pipeline

- a. No backfilling (except for securing pipe in place) over pipe will be allowed until the ENGINEER has had an opportunity to observe the joints, alignment and grade, in the section laid, but such observation shall not relieve the CONTRACTOR of further liability in case of defects occurring during or after placement of backfill.

B. Laying Sewer Pipe

1. PVC Pipe

- a. PVC sewer pipe laying shall comply with the requirements of ASTM D 2321 and the additional requirements of these Specifications and standard details of the Contract Drawings.
- b. Article 3.02.A of this Section 02700 shall apply to the installation of PVC sewer pipe. The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base. The bedding material shall conform to that specified in Article 3.02.A of this Section 02700.
- c. All PVC sewer pipe shall be installed in a manner to limit deflection of the pipe to 5 percent. A deflection test shall be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5 percent. If the deflection test is to be conducted using a rigid ball or mandrel, it shall have a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.
- d. When laser equipment is being used for laying PVC sewer pipe, the CONTRACTOR shall provide adequate ventilation through the pipe to prevent distortion of the beams.

2. Polyethylene (PE) Sewer Pipe

- a. PE sewer pipe laying shall comply with the requirements of these Specifications and standard details of the Contract Drawings.
- b. Article 3.02.A of this Section 02700 shall apply to the installation of PE sewer pipe. The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base. The bedding material shall conform to that specified in Article 3.02.A of this Section 02700.
- c. All PE sewer pipe shall be installed in a manner to limit deflection of the pipe to 5 percent. A deflection test shall be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5 percent. If the deflection test is to be run using a

rigid ball or mandrel, it shall have a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.

- d. When laser equipment is being used for laying PE sewer pipe, the CONTRACTOR shall provide adequate ventilation through the pipe to prevent distortion of the beams.
- e. One additional step in the installation of PE sewer pipe is required as the result of the fusion of the long lengths of pipe on the trench bank which produces a continuous pipeline without an open end where the invert elevation can be confirmed. Thus, it shall be necessary for the CONTRACTOR to carefully check the subgrade for the PE pipe, both for elevation and firmness at 5 foot intervals before installing the pipe in the trench.
- f. Because of the high coefficient of expansion of polyethylene, this pipe shall not be sealed into manholes or walls of other structures until at least 48 hours have elapsed after backfilling the pipe to allow adequate time for the pipe temperature to stabilize.

3. Ductile Iron Sewer Pipe

- a. Ductile iron sewers shall be laid in compliance with the requirements of these Specifications and standard details of Contract Drawings. Restrictions on depth of cover shall follow ANSI/AWWA C150/A21.50 requirements in Section 02610 for the various classes of ductile iron pipe. Joints shall be made with mechanical, restrained or rubber ring slip joint, according to the manufacturer's specifications and with tools recommended by them. A copy of the manufacturer's instructions shall be available at the site of work at all times when pipe is being laid. Joints shall be thoroughly cleaned and dry before pipes are laid in place.
- b. Cutting of pipe may be done using methods as the CONTRACTOR may elect, but the CONTRACTOR will be held responsible for breakage or damage caused by careless cutting or handling.
- c. No pipe shall be laid resting on rock, blocking or other unyielding objects, except where laid above ground on piers or in permanent tunnels. Exact lines and grades will be required on exposed pipelines placed on piers. Attachment of pipe to piers shall be as shown on the Standard Detail Drawings.
- d. In permanent tunnels pipe shall be laid with bells resting on tunnel liner or on blocks just behind bells. After pipe has been adjusted to proper line and grade, a bedding of Class 2500 concrete shall be poured under pipe to support the entire bottom quadrant. Payment for such bedding shall be included in the unit price for tunnel liner.

4. Cast Iron Soil Pipe

a. Sewer Line Contracts

- (1) Cast iron soil pipe shall generally be limited to usage for vertical stacks on sewer laterals when sewer main is located in deep, narrow trench or when trench is excavated into solid rock. Other use of soil pipe shall be per special applications as shown on the Drawings or acceptable to the ENGINEER.
- (2) Soil pipe shall be jointed with rubber gaskets or "boots" as specified with the pipe, this Section 02700 of these Specifications.
- (3) Soil pipe shall be installed such that the pipe is not allowed to rest on the side of trench. When in traffic areas, crushed stone shall be backfilled completely around the pipe for the complete vertical height of same. When outside traffic areas, pipe shall be backfilled with allowable material from trench excavation, hereinafter specified, with material mechanically tamped for complete vertical height.
- (4) Where cutting of pipe is required, it shall be done by wheeled cutters or by hammer and chisel, as the CONTRACTOR may elect. After cutting, all sharp edges shall be filed or ground smooth to prevent damage to gasket during jointing.
- (5) Soil pipe shall be attached to pipe of other materials as shown on standard details of Drawings.

b. Lump Sum Contracts

- (1) Where soil pipe is used for interior or exterior plumbing for water plants, wastewater treatment plants or other building construction, installation shall meet the specific criteria as delineated in the State Plumbing Code.

3.03 LAYING DRAIN PIPE

A. General

1. All general requirements hereinbefore stated pertaining to the installation of sewer pipe Article 3.02 of this Section 02700 shall also apply to the installation of drain pipe and storm sewers. Exceptions to these general requirements are as follows:
 - a. Article 3.02.A.7, pertaining to branch pipes and laterals.
 - b. Article 3.02.A.8, pertaining to connection of pipe to manholes or structures - the fabricated boot for connection of sewer pipe to

manholes will not be required for connection of drain pipe to manholes or other drainage structures.

B. Reinforced Concrete Drain Pipe

1. Installation of reinforced concrete drain pipe shall be per the previously stated instructions for installation of large diameter ductile iron or PVC sewer pipe, except that joints shall be sealed with mastic joint compound. Where reinforced concrete drain pipe is to be installed in an embankment area with "negative projection" trench condition, class of pipe, bedding and reinforcement shall be as shown on the Drawings.
2. Prior to applying the mastic joint compound, the complete surfaces of the bell and spigot shall be cleaned and primed with a primer recommended by the manufacturer of the mastic joint compound or with an approved emulsified asphalt. The mastic material shall then be applied to the bottom half of the bell and top half of the spigot ends of the pipes to be joined in such volume that when the joints are pulled tight, the joint compound will be extruded from the joint on both the inside and outside of the pipe. The excess material shall then be wiped or scraped away to provide a smooth, flush joint.

C. Corrugated Metal Drain Pipe

1. The requirements of paragraph 3.02.A of this Section 02700 shall be fully adhered to in the installation of corrugated metal drain pipe. When installing corrugated metal pipe, the invert elevation as shown on the Drawings and/or cut sheets shall be measured to the top of the corrugation of the flow line of pipe.
2. The wall thickness or gauge of the pipe shall be as shown on the Drawings. Where corrugated metal pipe is to be laid in an embankment area with a "negative projection" trench condition, the method of bedding and backfill shall be as shown on the Drawings.
3. Connecting bands shall be as specified in this Section 02700 of these Specifications and be of the same manufacturer as the pipe. Band shall be installed in such manner to completely join pipe to form a smooth invert flush with the ends of the pipe.
4. Where asphalt coated pipe is specified, the CONTRACTOR shall have on hand asphalt coating material of which the pipe was factory coated. Pipe coating damaged during shipping, unloading or on site handling shall be recoated in the field before lowering pipe into the trench. Pipe coating damaged during installation shall be recoated prior to backfilling.

3.04 TRENCH BACKFILL - SEWER AND DRAIN PIPE

A. General

1. Excavated materials from trenches and tunnels, in excess of quantity required for trench backfill, shall be disposed of by the CONTRACTOR. It shall be the responsibility of the CONTRACTOR to obtain location or permits for its disposal. Unit prices for furnishing and laying pipe, which includes trench excavation, tunneling, and backfill, shall include the cost of disposition of excess excavated materials, as set forth herein, with no additional compensation being allowed for hauling.
2. No extra charge shall be made for backfilling of any kind, except as herein specified. Backfilling shall be included as a part of the price for furnishing, laying, trenching, and backfilling. No extra charge shall be made for supplying outside materials for backfill except where fills above existing ground are necessary and payment is designated on the Drawings or in the Specifications. If backfilling of the trench or surface restoration is not properly completed, a proportionate part of the unit price for furnishing, laying, trenching, and backfilling shall be retained from payment estimates.
3. Railroad company and Department of Highways requirements in regard to backfilling will take precedence over the above general Specifications where they are involved.
4. Mechanical tamping, where required by the ENGINEER in locations other than those specifically designated herein, shall be paid for per unit price bid for mechanical tamping.
5. Before completion of the Contract, all backfills shall be reshaped, holes filled, surplus materials hauled away, all permanent walks, street, driveways, highway paving replaced, and all sodding, seeding, and planting work performed.

B. Haunching

1. Upon completion of bedding and laying the sewer or drain pipe, the CONTRACTOR shall place crushed rock, Kentucky Department of Highways Size 9 dependent on size of pipe, or the same material used for pipe bedding on both sides simultaneously to the top of the pipe. This material shall be hand placed using shovel or other satisfactory tool to work the haunching material completely under the bottom quadrant and around the sides of the pipe to assure the maintenance of alignment of the pipe. No compaction of this material is required other than that obtained by the workmen walking on the material during placement.
2. The haunching material is required for all sewer or drain pipe installed in open trenches except where concrete pipe arch is required, in which case the haunching material is required to the bottom of the arch. Where

concrete cradle is required, the haunching material shall be placed from top of cradle to top of pipe.

3. The cost of furnishing and placement of the haunching material shall be included in the CONTRACTOR'S bid for furnishing and laying the pipe.

C. Initial Backfill

1. Upon completion of the haunching material to the top of the pipe, initial backfill shall be placed as hereby specified. This material shall serve as protection for the top of pipe reducing the possibility of damage to the pipe during the placement of backfill for the remainder of the trench depth.
2. When sewer or drain pipe is located outside traffic areas, the initial backfill material shall be crushed rock (Kentucky Department of Highways No. 9) placed above the pipe to the level hereinafter stated.
3. When the sewer or drain pipe is located within traffic areas, the initial backfill shall be crushed rock, or the material used for bedding and haunching the pipe, of the same gradation of the pipe bedding material. Other alternate materials may be used only with the specific written permission of the ENGINEER when the work is located inside traffic areas.
4. In the case of steel, cast iron, ductile iron pipe the initial backfill shall be hand placed to a point 6 inches above the barrel of the pipe. In case of plastic pipe, the initial backfill shall be hand placed and evenly spread to a point 12 inches above the pipe barrel for up to 4 feet cover, to a point 18 inches above the barrel for 4 feet to 10 feet cover, and 24 inches for over 10 feet cover.
5. The initial backfill material is required over sewer and drain pipe in all open trenches. The cost of the initial backfill material and placement of same shall be included in the CONTRACTOR'S bid for furnishing, laying, trenching and backfilling.

D. Final Backfill

1. Outside Traffic Areas
 - a. After the above specified initial backfill is hand placed, rock may be used in machine placed backfill in pieces no larger than 8 inches in any dimension and to an extent not greater than one-half the volume of the backfill materials required to backfill trench. Larger rock fill will be allowed in wide trenches where side slopes are low enough to prevent rock from dropping over pipe-line. If additional earth is required, it must be obtained and placed by the CONTRACTOR. Filling with rock and earth shall proceed simultaneously, in order that all voids or pockets, created by rock backfill, may be filled with earth. Machine backfilling may be employed with tamping, except as hereinafter restricted, provided

caution is used in quantity per dump and in uniformity of level of backfilling. Backfill material must be uniformly ridged over trench, and excess hauled away, with no excavated rock over 1/2-inch diameter or pockets of crushed rock or gravel in top 12 inches of backfill, the top 12 inches reserved for topsoil or material more suited to sustain surface growth. Ridged backfill shall be confined to the width of the trench and not allowed to overlap onto firm original earth, and its height shall not be in excess of that required to provide for settlement of backfill.

2. Inside Traffic Areas

- a. Where sewer and drain pipe is located in street, highway, railroad, sidewalk and driveway crossings or within any roadway paving, or about manholes, valve and meter boxes located in such paving, fill trench to within 6 inches of the surface with Kentucky Department of Highways No. 9 crushed stone, or other gradation acceptable to the ENGINEER. In order to accommodate compacted temporary surfacing it may be necessary to bulkhead or otherwise confine the stone fill at the open end of the trench.

E. Cleanup and Temporary Surfacing

1. General

- a. Immediately following the placement of final backfill, all rock and debris, including crushed rock or gravel from construction operations, shall be removed from yards and fields. Streets, drives and walks shall be broomed to remove all earth and loose rock. The cleaning of streets, drives, and walks shall be of such extent to hold dust to a minimum. Loose earth and rock shall in no case be swept or washed into storm sewers or drains as a method of removal, all such material being loaded and hauled away from the site.
- b. If acceptable cleanup operations are not completed within an acceptable period of time after the completion of final backfilling, a proportionate part of the price bid for trenching and backfilling shall be retained from partial payment estimates until acceptable cleanup is completed.

2. Temporary Surface Cover - Unpaved Areas

- a. Upon completion of acceptable cleanup work, the ground surface shall be prepared for temporary seed, permanent seed or sod per the requirements of Section 02930 of these Specifications.

3. Temporary Surface Replacement - Paved Areas

- a. Temporary surfacing of street, highway, railroad, sidewalk and driveway crossings, or within any roadway paving, or about

manholes, valve and meter boxes located in such paving, shall consist of 6 inches compacted dense graded aggregate as specified under Section 02235 for temporary walkway or road surfacing, placed and compacted in the trench. Compaction shall be accomplished by methods which shall be sufficient to confine stone to the trench under normal traffic. Backfills shall be maintained easily passable to traffic at original paving level until acceptance of project or replacement of paving or sidewalks. The amount of crushed stone placed shall be paid for at the unit price per ton as shown in Section 02700 herein, titled "BASIS OF PAYMENT." No payment will be made for crushed rock surfacing required as a result of unnecessarily wide trenches, omission of sheeting and shoring, or damage by the CONTRACTOR'S equipment, or for maintenance of surface level.

- b. After the initial placement of the 6-inch depth of temporary surfacing, the CONTRACTOR shall be required to maintain the temporary surfacing to street or road surface level at no additional cost to the OWNER. This requirement shall continue until the replacement of permanent surfacing.

3.05 FIELD QUALITY CONTROL - TESTING SEWERS FOR LEAKS, INFILTRATION, AND DEFLECTION

A. Sewers

1. General

- a. All sewers constructed under this Contract shall be tested for leaks and infiltration using methods as hereinafter specified.
- b. The cost of all testing of sewer lines and manholes shall be included in the unit price bid for pipe and manholes. The CONTRACTOR shall furnish all materials, equipment and labor required for all types of tests, the ENGINEER being responsible only for directions, recording data and calculating air losses and/or infiltration rates.

2. Sequence

a. Initial Testing

- (1) The first manhole to manhole section of sewer laid under this Contract, for each size of pipe and type of joint, shall be given a smoke test prior to the sewer being backfilled and while the sewer trench is dewatered to bottom of the pipe being tested.
- (2) Should, based on the results of the test of the first section of pipe laid, the materials being used and the CONTRACTOR'S installation procedures prove to be

satisfactory, subsequent smoke testing may, at the discretion of the ENGINEER, be waived. Should, however, based on the results of the test of the first section of pipe laid, the material being used and/or the CONTRACTOR'S installation procedures prove to be unsatisfactory, subsequent smoke testing shall, at the discretion of the ENGINEER, be continued until such time that, in the opinion of the ENGINEER, problems with materials and/or installation procedures have been corrected.

- (3) Such subsequent testing shall likewise be done while trenches are dewatered to bottom of pipe to be tested and immediately after completion of either the public sewer lines or laterals, in not more than 2 sections between manholes at a time. All defective work, as so proven by the smoke test, shall be immediately repaired and retested until proven to be satisfactory.
- (4) Observation of pipe laying and smoke testing shall in no way relieve the CONTRACTOR of the responsibility of conducting the required low pressure air test, infiltration tests, or correcting poor workmanship.

b. Subsequent Testing

- (1) As soon as it is practicable after installing and backfilling sewers, and before putting new sewers into service, low pressure air tests shall be made from manhole to manhole, or up to a maximum of 500 feet of sewer main and 500 feet of sewer laterals at a time, as directed by the ENGINEER. The maximum allowance for air loss during testing shall be determined by tables of minimum holding time for a pressure drop of 1.0 psi and are based on an average loss of 0.0015 cubic feet of air per minute per square foot of internal pipe surface, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater present.
- (2) Upon completion of installation and backfilling of all sewers constructed under this Contract, the low pressure air test is required for all sewers so constructed.

c. Additional Testing

- (1) Upon completion of the required initial (smoke) testing and required subsequent (low pressure air) testing, and prior to placing the sewer into operation, if ground and/or surface water flow is observed in the completed sewer, the ENGINEER may order infiltration tests be accomplished to determine whether the flow is within acceptable and allowable limits. This additional testing may be required

even though the results of the initial smoke testing and subsequent low pressure air testing indicate the sewers are substantially watertight. The infiltration tests shall be conducted, on order of the ENGINEER, as hereinafter specified.

3. Equipment

a. Smoke Testing

- (1) The smoke testing blower shall have a capacity of at least 1,200 cfm.
- (2) The smoke bombs shall produce a chemical reaction generated, white to gray smoke, leaving no residue, and be nontoxic and nonexplosive. Each bomb shall be capable of producing 25,000 cubic feet of smoke per 3 minutes.

b. Low Pressure Air Testing

- (1) The air test equipment used shall meet the following minimum requirements:
 - (a) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - (b) Pneumatic plugs shall resist internal test pressures without requiring internal bracing or blocking.
 - (c) All air used shall pass through a single control panel.
 - (d) Three individual hoses shall be used for the following connections:
 - (i) From control panel to pneumatic plugs for inflation.
 - (ii) From control panel to sealed line for introducing the low pressure air.
 - (iii) From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

4. Procedures

a. Safety Precautions

- (1) The air test may be dangerous if a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts.

Inasmuch as a force of 25 lbs is exerted on an 8-inch plug by expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

- (2) As a safety precaution, pressurizing equipment shall include a regulator set at 10 psi to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

b. Low Pressure Air Test

- (1) All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
- (2) Clean pipe to be tested by propelling snug fitting inflated rubber ball through the pipe with water.
- (3) Plug all pipe outlets with suitable test plugs. Brace each plug securely.
- (4) If the pipe to be tested is submerged in groundwater, insert a pipe probe by boring or jetting into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when the air passes slowly through it. This is the backpressure due to groundwater submergence over the end of the probe. All gauge pressures in the test shall be increased by this amount.
- (5) Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
- (6) After an internal pressure of 4.0 psig is obtained, allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
- (7) When pressure decreases to 3.5 psig, start stopwatch. Determine the time required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times for runs of single pipe diameter and for systems of 4-inch, 6-inch, or 8-inch laterals in combination with trunklines are indicated in the following table based on air loss calculations per ASTM F-1417.

Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	7:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:42	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:36
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	35:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	35:30	88	17.306 L	28:51	43:16	57:41	72:07	81:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	134:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

c. Infiltration Test

- (1) Before putting new sewer lines into service, weir test shall be made of flow of water in the sewers from manhole to manhole or up to a maximum of 3,000 foot sections at a time, as directed by the ENGINEER. These tests shall be made when, in the ENGINEER'S judgment, groundwater level is equal to the highest groundwater condition in a normal year.
- (2) The maximum allowance for all sewer pipe materials shall be 100 gallons per 24 hours per inch diameter per mile of sewer pipe and manholes.

d. Deflection Test

- (1) A deflection test shall be performed on all flexible sewer pipe. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5 percent. If the deflection test is to be run using a rigid ball or mandrel, it shall have a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices. Pipe deflection shall be measured and recorded by the CONTRACTOR in the presence of the ENGINEER using appropriate methods approved by the pipe manufacturer and acceptable to the ENGINEER.

5. Repairs and Acceptance

- a. If the sewer fails to meet the requirements of the leakage and/or infiltration tests, the CONTRACTOR shall, at his own expense,

determine the source of leakage and/or infiltration and make the necessary repairs or replacements.

- b. If any sewer fails to meet the requirements of the deflection test, the CONTRACTOR shall, at his own expense, replace all failed pipe as necessary to comply with the deflection requirements. All replacement pipe shall also be tested for deflection.
- c. On completion of sewer lines, all sewers and manholes will be inspected for foreign matter, including sand brought in by infiltration, and any such matter shall be removed before final acceptance of the lines. Any visible leakage at manholes or into lines shall be corrected regardless of the results of the required tests.

B. Drains and Storm Sewers

- 1. It is not the intent herein that drains and storm sewers shall be constructed watertight. If, however, groundwater flows are observed in the pipeline in fairly large quantities, the ENGINEER may require infiltration tests, as herein specified, to be completed in order to determine the amount of groundwater entering the completed pipeline. Should leakage result in a volume flow exceeding 500 gallons per inch diameter per mile of pipe per 24 hours, the CONTRACTOR shall be required to locate and repair leaks occurring in the system.
- 2. Culverts and cross drains shall be inspected visually for groundwater leakage.

3.06 BASIS OF PAYMENT

A. Excavation and Backfilling

- 1. Trenching and Backfilling
 - a. Lump Sum Contracts
 - (1) The CONTRACTOR'S lump sum bid shall include all costs for trenching and backfilling.
- 2. Solid Rock Excavation
 - a. Classified Excavation
 - (1) Rock excavation shall be paid for at an extra unit price per cubic yard for extra cost of its excavation over that for excavating earth. Therefore, its quantity will not be subtracted from earth excavation quantities.

b. Unclassified Excavation

- (1) Excavation shall be unclassified and the cost of all excavation of whatever nature and state, including solid rock, shall be included in the CONTRACTOR'S unit price bid for each item of construction requiring excavation.

3. Search and Extra Depth Trench Excavation

- a. "Search" trench excavation shall be the actual measured excavation within limits as acceptable to the ENGINEER.
- b. "Extra Depth" trench excavation shall be the calculated yardage below the lowest point of excavation which would normally have been required for construction.

- c. Trench width limitations for either condition shall be as listed in the following table:

For 6" Pipe 2'-6"	For 15" Pipe 2'-10"
For 8" Pipe 2'-9"	For 16" Pipe 2'-11"
For 10" Pipe 2'-9"	For 18" Pipe 3'-2"
For 12" Pipe 2'-9"	For 20" Pipe 3'-5"
For 14" Pipe 2'-9"	For 21" Pipe 3'-6"
For 24" Pipe 3'-8"	

- d. Payment shall be by the cubic yard removed, including backfilling.

4. Mechanical Tamping

- a. Mechanical tamping is defined as backfill placed and compacted by power driven mechanical equipment to a greater density than can be achieved by natural settlement or hand tamping methods. Mechanical tamping will be required when ordered by the ENGINEER with payment by the cubic yard so compacted. Measurement, but not actual extent of the mechanical tamping, shall be limited by the numerical maximum allowable trench width (for each size pipe) as shown in the table listed under "Search and Extra Depth Trench." Payment for mechanical tamping shall not include the specified haunching or initial backfill required above and below the top of pipe.

5. Crushed Rock Trench Backfill

- a. When crushed rock trench backfill is listed as a pay item on the Form of Proposal, payment for the crushed stone or accepted granular material will be made by the ton so placed limited to the following calculation:

(1) Maximum trench widths as shown in the following table:

For 6" Pipe 2'-6"	For 15" Pipe 2'-10"
For 8" Pipe 2'-9"	For 16" Pipe 2'-11"
For 10" Pipe 2'-9"	For 18" Pipe 3'-2"
For 12" Pipe 2'-9"	For 20" Pipe 3'-5"
For 14" Pipe 2'-9"	For 21" Pipe 3'-6"
For 24" Pipe 3'-8"	

- b. Payment shall be by the cubic yard removed, including backfilling.

- (1) Depth of cover less the previously specified initial backfill and less the top 6 inches of trench.
- (2) Weight of crushed stone or approved granular material not to exceed 100 lbs/cu ft.
- (3) Length limited to 1 foot beyond edge of traffic area.

- c. When crushed rock trench backfill is NOT listed as a pay item on the Form of Proposal, the cost of same shall be incorporated in the CONTRACTOR'S bid for trenching and backfilling.

B. Trench and Pipe Stabilization

1. Extra Excavation

- a. Extra excavation required for trench or pipe stabilization shall be paid by the cubic yard so excavated under the item "Search and/or Extra Depth Trench Excavation" based on the limitations for that item.

2. Crushed Stone for Trench Stabilization

- a. Crushed stone ordered by the ENGINEER for trench stabilization shall be paid by the ton so placed.

3. Crushed Stone for Pipe Bedding

- a. Additional crushed stone bedding ordered by the ENGINEER for pipe stabilization shall be paid by the ton so placed.
- 4. Plain or Reinforced Concrete Arch
 - a. Plain or reinforced concrete arch called for on the Drawings and/or ordered by the ENGINEER shall be paid for by the linear foot of pipeline upon which it is placed. The Form of Proposal will indicate which method is to be used.
- 5. Plain or Reinforced Concrete Cradle
 - a. Plain or reinforced concrete cradle called for on the Drawings and/or ordered by the ENGINEER shall be paid for by the linear foot so placed.

C. Sewer and Drain Pipe and Accessories

- 1. Lump Sum Contracts
 - a. All work shall be included in the CONTRACTOR'S lump sum bid.

D. Temporary Surface Replacement

- 1. The amount of crushed stone placed shall be paid for at the unit price per ton up to the maximum limits of 225 pounds per linear foot of trench over which it is placed for pipe sizes through 16 inches, 300 pounds per linear foot for pipe sizes 18 through 24 inches and 400 pounds per linear foot for sizes 27 inches through 48 inches. The ENGINEER shall have control of thickness and width to be placed and paid for, and may order changes in depth and width as conditions dictate. No payment will be made for crushed rock surfacing required as a result of unnecessarily wide trenches, omission of sheeting and shoring, or damage by the CONTRACTOR'S equipment, or for maintenance of surface level.

END OF SECTION

SECTION 02713
FOUNDATION DRAINAGE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of foundation drainage system work is shown on the Drawings and includes the following:
 - 1. Foundation slab drainage systems.
 - 2. Foundation perimeter drainage systems.
 - 3. Foundation wall drainage system.

1.02 RELATED WORK

- A. Dewatering is included in Section 02140.
- B. Earth and Rock Work is included in Section 02200.
- C. Crushed Stone and DGA is included in Section 02235.

1.03 SUBMITTALS

- A. Shop drawings and test reports shall be submitted to the ENGINEER in accordance with Section 00700 (00710).

PART 2 PRODUCTS

2.01 DRAINAGE PIPE AND FITTINGS, MATTING AND FILTER FABRIC

- A. Furnish drainage and pipe complete with bends, reducers, adapters, couplings and joint materials.
- B. Furnish perforated polyvinyl chloride pipe meeting ASTM D 2729-83 or heavy-duty, slotted corrugated polyethylene drainage tubing meeting AASHTO M252 or M294, as manufactured by Advanced Drainage Systems, Inc., Columbus, OH, or equal.
- C. Furnish foundation wall drainage matt, as required on the Drawings, consisting of 2-layer composite of polyester non-woven filter fabric heat-bonded to a compression-resistant nylon matting of open, 3-dimensional construction, Enkadrain Type 9120, as manufactured by Enka Company, Enka, North Carolina, or equal.
- D. Furnish synthetic drainage filter fabric as indicated on the Drawings, Tygar Style 3401 as manufactured by DuPont, Wilmington, DE; Bidim by Monsanto Textiles Co., St. Louis, Missouri, or equal, unless otherwise required or permitted on the Drawings.

2.02 CRUSHED ROCK MATERIALS

A. Drainage Fill and Filter Material

1. Crushed stone shall be No. 57 meeting the applicable requirements of the Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction, 1988 Edition.

PART 3 EXECUTION

3.01 INSTALLATION OF DRAINAGE SYSTEMS

A. Under Foundation Slabs

1. Place supporting layer of filtering material over foundation rock and/or compacted subgrade to depth indicated on the Drawings, or if not indicated, to a compacted depth of not less than 4 inches.
2. Lay drain pipe solidly bedded in filtering material. Provide full bearing for each pipe section throughout its length, to true grades and alignment, sloping in direction of flow. Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required. Install filter fabric and accessories as indicated on the Drawings.
3. Test or check pipe and appurtenances to assure free flow before backfilling with drainage fill. Remove obstructions, replace damaged components, and retest system until acceptable.
4. Carefully compact drainage fill over pipe to slab subgrade as indicated on the Drawings, taking care to preserve the drainage pipe system and appurtenances.

B. Around Foundation Perimeter

1. Install drainage filter fabric, crushed rock, pipe, pressure relief valves and accessories as indicated on the Drawings. Follow applicable procedures outlined in A.1 and A.2 above.
2. Test or check pipe and appurtenances to assure free flow before backfilling with drainage fill. Remove obstructions, replace damaged components, and retest system until acceptable.
3. Carefully place drainage fill over pipe, encapsulating with filter fabric as indicated on the Drawings, taking care to preserve the drainage pipe system and appurtenances.

C. Against Foundation Walls to be Backfilled

1. Place drainage fill against walls to be backfilled as indicated on the Drawings. Install drainage matting as permitted or required in strict accordance with manufacturer's recommendations.

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2. Place drainage fill material concurrently with compacted soil backfill to an elevation 2 feet below finished regrade. Overlay drainage fill material with one layer of 15 pound asphalt or tar-saturated felt, or filter drainage fabric, overlapping edges at least 12 inches.
3. Compact low permeability fill material to within 6 inches of finished grade, placing material in layers not exceeding 6 inches in loose depth and thoroughly compacting each layer. Compact topsoil in final 6 inches to indicated finish grade elevations, sloping the ground surface away from structures.

END OF SECTION

SECTION 02930
SODDING AND SEEDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to perform sodding and seeding as shown on the Contract Drawings and as specified herein.
- B. All areas disturbed by construction operations shall receive a protective cover of vegetation. The work shall consist of preparing the area for treatment, furnishing and placing soil amendments, fertilizer, sod, seed, inoculants, mulch and plantings as specified in the designated areas.

1.02 RELATED WORK

- A. Special requirements for materials and equipment are given in Sections 00700/00710 and 01600.
- B. Special sequence or schedule requirements (if any) are specified in Section 01010 - Summary of Work.
- C. Section 02370 - Erosion and Sediment Control

1.03 QUALIFICATIONS

- A. The work shall be done by a provider who is experienced, reputable, and qualified in the tasks required.

1.04 SUBMITTALS

- A. Shop Drawings and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ENGINEER in accordance with Section 00700/00710 - Submittals. Included in the submittal shall be material application rates.
- B. Where fertilizer is furnished from bulk storage, the CONTRACTOR shall furnish a supplier's certification of analysis and weight. When required by the Contract, a representative sample of the fertilizer shall be furnished the OWNER for chemical analysis.

1.05 WARRANTY

- A. Refer to Division 0 and 1 for warranty requirements.

1.06 REFERENCES

- A. Where material or construction standards are noted, such as ASTM, ECTC, etc., the standard used shall be the latest edition of the standard available at the time of advertisement.

PART 2 PRODUCTS

2.01 SOD

- A. The sod to be used shall be Kentucky Bluegrass comparatively free from weeds or heavy root structure, cut in strips of 10 inches to 12 inches wide, 18 inches to 24 inches long, with a thickness of 1 1/2 inches to 2 inches.

2.02 SEED

- A. All seed shall conform to the current rules and regulations of the state where it is being used and be from the latest crop available. It shall meet or exceed the standards for purity and germination listed herein.
- B. Seed shall be labeled in accordance with the state laws and the U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures will be evidence of purity and germination. No seed will be accepted with a date of test of more than 9 months prior to the date of delivery to the site.
- C. The seed for use on this project shall be of the type as listed below with the listed germination and purity qualifications.

<u>Species</u>	<u>% Purity</u>	<u>% Germination</u>
Tall fescue (KY-31) (<u>Festuca arundinacea</u>)	98.5	85
Ryegrass (<u>Lolium multiflorum</u>)	98.0	90
Oats (<u>Avena sativa</u>)	98.0	90
Rye, grain (<u>Secale cereale</u>)	97.0	85
Redtop (<u>Agrostis alba</u>)	90.0	80
Ky. Bluegrass (<u>Poa pratensis</u>)	90.0	80

2.03 FERTILIZER

- A. Unless otherwise specified the fertilizer shall be a commercial grade fertilizer or as specified herein. The fertilizer shall meet the standard for grade and quality specified by state law.

2.04 INOCULANTS

- A. The inoculant for treating legume seeds shall be a pure culture of nitrogen fixing bacteria prepared specifically for the species and shall not be used later than the date indicated on the container or as otherwise specified. A mixing medium, as recommended by the manufacturer, shall be used to bond the inoculant to the seed. Two times the amount of the inoculant recommended by the manufacturer shall be used, except when seed is applied by use of hydraulic seeder, in which case 4 times the amount of inoculant recommended by the manufacturer shall be used. Seed shall be sown within 24 hours of treatment and shall not remain in the hydraulic seeder longer than 4 hours.

2.05 SOIL AMENDMENTS

- A. Lime shall consist of standard ground agricultural limestone, or equal. Standard ground agricultural limestone is defined as ground limestone meeting current requirements of the State Department of Agriculture. Agricultural lime or other needed soil amendments shall be uniformly applied at the rate specified herein.

2.06 ASPHALT EMULSION

- A. Asphalt emulsion shall conform to the requirements of ASTM D 977, "Emulsified Asphalt." It shall not contain volatile organic compounds or other compounds which are detrimental to seed germination and growth. The emulsified asphalt may be rapid, medium, or slow cure materials. When straw mulch is used, asphalt emulsion shall be used to keep the straw mulch in place.

2.07 STRAW MULCH MATERIALS

- A. Straw mulch materials shall consist of wheat, oat, or rye straw, hay, grass clippings cut from any native grasses or other plants acceptable to the ENGINEER. The mulch material shall be air dry, reasonably light in color, and shall not be musty, moldy, caked, or otherwise of low quality. The use of mulch that contains noxious weeds will not be permitted. The CONTRACTOR shall provide a method satisfactory to the ENGINEER for determining weight of mulch furnished.

2.08 FLEXIBLE GROWTH MEDIUM

A. Acceptable Manufacturers

- 1. PROFILE Products LLC, Buffalo Grove, IL 60089, Phone: 800-366-1180, Fax: 847-215-0577, website - www.profileproducts.com; or equal.

B. Materials

- 1. Flexible Growth Medium: Flexterra™ FGM, as manufactured by PROFILE Products, LLC and shall conform to the following typical property values when applied at a rate of 3500 pounds per acre.

	TEST METHOD	ENGLISH	SI
Physical			
Mass Per Unit Area	ASTM D-6566	11.5 oz/yd ²	390 g/m ²
Thickness	ASTM D-6525	0.19 in	4.8 mm
% Ground Cover	ASTM D-6567	99%	99%
Water Holding Capacity	Proposed ASTM	1500%	1500%
Flexural Rigidity (wet)	ASTM D-6575	5 oz-yd	10,000 mg-cm
Cure Time	Observed	< 2 hr	< 2 hr
Color (fugitive dye)	Observed	Green	Green
Endurance			
Functional Longevity	Observed	Up to 1 yr	Up to 1 yr
Performance			
Cover Factor (6 in/hr event)	ECTC Test Method #2	0.0066	0.0066
% Effectiveness	ECTC Test Method #2	99.34%	99.34%
Shear Stress	ECTC Test Method #3	1 lb/ft ²	48 Pa
Vegetation Enhancement	ECTC Test Method #4	800%	800%

Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface. One minus Cover Factor multiplied by 100% equals % Effectiveness.

C. Composition

1. All components of the FGM shall be pre-packaged by the Manufacturer to assure material performance and in compliance with the following values. **Under no circumstances will field mixing of additives or components be accepted.**

Thermally Processed Wood Fibers – 74.5% ± 3.5%

Proprietary Cross Linked Hydro-Colloid Tackifiers & Activators – 10% + 1%

Proprietary Crimped, Interlocking Fibers – 5% + 1%

Moisture Content – 10.5% ± 1.5%

2.09 OTHER MULCH MATERIALS

- A. Mulching materials, such as wood cellulose fiber mulch, emulsion type, synthetic fiber mulch, netting, mesh, and other mulching materials that may be required for specialized locations and conditions, when specified, must be accompanied by the manufacturer's recommendations for methods of application.

PART 3 EXECUTION

3.01 EXTENT

A. Lump Sum Contracts

1. Sodding

- a. All sodded areas within the construction site steeper than 1 foot vertical to 3 feet horizontal, and berms less than 4 feet wide at all structures shall be sodded, or seeded using flexible growth medium, unless otherwise shown on the Drawings or herein specified.

2. Seeding

- a. Except for areas occupied by structures, roadways, walkways, and sodded areas specified above, the entire area disturbed by construction operations shall be seeded.

3. CONTRACTOR'S Options

- a. Where surface grasses and cover are similar in nature throughout the length of the project, the CONTRACTOR may provide seed of one type or mixture for the entire project provided there are no objections by individual landowners involved and with permission of the OWNER and ENGINEER. In such cases, the seed type and/or mixture shall be that specified for lawn areas. Pasture and/or cover crop mixtures shall not be used for lawn application for any reason.
- b. When construction facilities or construction operations are located on or encroach on privately owned properties, the CONTRACTOR may, at his election, negotiate with the individual landowners for restoration of the surface. This negotiation and settlement may be for materials or labor or both as agreeable to the individual property owner. In such cases, the CONTRACTOR shall obtain from the individual landowner a "Release of Claims" releasing the OWNER from any further liability for surface restoration, a copy of which shall be provided for the OWNER and ENGINEER. This option shall apply to surface restoration only. The CONTRACTOR shall be responsible for cleanup and regrading work and for any settlement of the trench or graded area within the one year guarantee period.

3.02 SOIL PREPARATION

- A. All areas to be seeded or sodded shall be thoroughly cleaned, removing all debris of whatever nature. After the area has been cleaned, the soil for seeding and sodding shall be prepared as follows:

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1. Loosen the soil to a depth of not less than 4 inches.
2. Work the soil until it is in good condition, raking with hand rake to complete the soil preparation and make final finished grade.
3. Broadcast 15 pounds of phosphorus rich fertilizer such as a good starter fertilizer or 10-20-10, on each 1,000 square feet of area (for sodded areas only).
4. Rake area to receive sod, to spread fertilizer and work it into the soil.
5. On areas to be seeded, the raking in of fertilizer may be done concurrently with raking in of seed as hereinafter specified.

3.03 SODDING

- A. The timing of resodding shall be controlled by the ENGINEER. Ground shall be prepared and fertilized as previously specified under Article 3.02 of this Specification Section. In small patches, supplying of 3 inches of topsoil and raking may be substituted for disking.
- B. The strips of sod are to be laid so the joints will be broken. After the sod has been laid, it is to be watered thoroughly then rolled with a roller weighing 300 to 400 pounds, supplemented by hand tamping of sections inaccessible by roller.
- C. After the sod has been put down, as described above, each piece is to have a minimum of 2 stakes to hold it in place, the stakes to be 1/2 inch square, 10 inches long, and driven into the ground with 2 inches of the stake left above the sod.
- D. Sod shall be kept moist by watering for at least one month or until the Contract is completed and the facilities accepted by the OWNER for operation.

3.04 SEEDING

A. Temporary Cover (All Areas)

1. This item shall consist of seeding a temporary cover of grass, or grass and small grain, on areas disturbed on the construction site which will not be redisturbed within a 60 day period. The determination of the area to be temporarily seeded and the time of seeding shall be controlled by the ENGINEER.
2. The seed mixtures to be used for temporary cover will be governed by the time of year the seeding is accomplished. The mixtures and time of seeding shall be as follows:

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- a. Time of Seeding - 2/15 to 6/1
 - (1) Rye 1-1/2 bushels and ryegrass 25 pounds per acre; or tall fescue 30 pounds and ryegrass 20 pounds per acre.
- b. Time of Seeding - 6/2 to 8/15
 - (1) Tall fescue 30 pounds and ryegrass 20 pounds per acre; or, spring oats 2 bushels and ryegrass 30 pounds per acre.
- c. Time of Seeding - 8/16 to 2/14
 - (1) Rye 2 bushels and ryegrass 20 pounds per acre; or, tall fescue 30 pounds and ryegrass 20 pounds per acre.
- d. Lime will not be required for temporary seeding.
- e. Fertilize at the rate of 400 pounds per acre of 10-10-10 fertilizer, or equivalent, broadcast uniformly on the area to be seeded.
- f. All seed shall be broadcast evenly over the area to be seeded and cultipacked or otherwise pressed into the soil. Seed and fertilizer may be mixed together and applied after the seed bed has been prepared.
- g. Apply mulch for temporary seeding at the rate of 1.5 - 2 tons per acre. Mulch shall be applied to all areas regardless of the time seeded. See 3.05 below for use of a flexible growth medium in place of mulch.

B. Seeding (Permanent Cover)

- 1. This item consists of seeding all areas disturbed during construction. All grading and/or filling of rills and gullies to a cross section acceptable to the ENGINEER shall be included in the seed bed preparation.
 - a. Pastures and Cover Crops
 - (1) All areas to be seeded shall be seeded with 50 pounds of tall fescue (KY-31) per acre, subject to the provisions hereinbefore stated in this Specification group.
 - (2) Prepare seed bed as specified in Article 3.02 of this Specification Section unless instructed otherwise by the ENGINEER. Check the pH of the soil. This should be done wherever the soil type changes, color or texture varies. If the soil pH is outside the range of 6.0 - 7.5 adjust the pH to bring it into this range. Apply 2 tons of lime per acre to raise the pH or apply aluminum sulfate as needed to lower the pH.

- (3) Apply mulch at the rate of 1.5 - 2 tons per acre. Mulch shall be applied to all areas regardless of the time seeded. See 3.05 below for use of a flexible growth medium. Tall fescue straw shall be used at the rate of 2 tons per acre. See 3.05 below for use of a flexible growth medium in place of mulch.

b. Lawns and Yards

- (1) This item consists of seeding all areas equivalent to residence lawns or yards disturbed during construction. All grading and filling shall be accomplished in a manner acceptable to the ENGINEER prior to the placement of seed and materials. Seed shall consist of a mixture of one part Red Top and 3 parts high grade Kentucky Bluegrass seed mixed together and broadcast at the rate of 2 lbs. to each 1,000 square feet of surface, to be seeded.
- (2) Check the pH of the soil. This should be done wherever the soil type changes, color or texture varies. If the soil pH is outside the range of 6.0 – 7.5 adjust the pH to bring it into this range. Apply 2 tons of lime per acre to raise the pH or apply aluminum sulfate as needed to lower the pH. Apply 1500 pounds of phosphorus rich fertilizer such as a good starter fertilizer or 10-20-10 fertilizer per acre.
- (3) Apply mulch at the rate of 2 tons per acre. Mulch shall be applied to all lawn areas regardless of the time seeded. See 3.05 below for use of a flexible growth medium in place of mulch.

3.05 FLEXIBLE GROWTH MEDIUM

A. INSTALLATION

1. Strictly comply with manufacturer's installation instructions and recommendations. For optimum pumping and application performance use approved mechanically agitated, hydraulic seeding/mulching machines with a fan-type nozzle (50-degree tip). Apply FGM from opposing directions and to achieve best soil coverage.
2. Erosion Control and Re-vegetation

For maximum performance, apply FGM in a two-step process:

- a. Step One: Mix and apply seed and soil amendments with small amount of FGM for visual metering.

- b. Step Two: Mix and apply FGM at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.
 - c. Depending upon site conditions FGM may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with manufacturer for further details.
 3. Mixing: A mechanically agitated hydraulic-application machine is recommended:
 - a. Fill tank to middle of agitator shaft or tank about 1/3 full of water. Turn on pump to wet or purge lines. Begin agitating. Keep adding water slowly while adding the FGM at a steady rate.
 - b. Consult application and loading charts to determine number of bags to be added. Mix at a rate of 50 lbs. of FGM per 125 gallons (23kg/475 liters). Contact equipment manufacturer to confirm optimum FGM mixing rates.
 - c. All FGM should be loaded when the tank is approximately 3/4 full.
 - d. Fertilizer should be added once the tank is nearly full.
 - e. Before applying, mix the slurry for at least 10 minutes after adding the last amount of FGM. This is very important to fully activate the bonding additives and to attain proper viscosity.
 - f. Turn off recirculation valve to minimize potential for air entrainment within the slurry.
 4. Application:
 - a. Use a fan-type nozzle (50-degree tip) whenever possible for best soil surface coverage. Apply FGM from opposing directions to soil surface, reducing the “shadow effect” and assuring a minimum of 95% of soil surface coverage. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 feet (30m). Install materials at the following minimum application rates:

Condition	English	SI
<3H to 1V	3000 lb/ac	3400 kg/ha
>3H to 1V and <2H to 1V	3500 lb/ac	3900 kg/ha
>2H to 1V and <1H to 1V	4000 lb/ac	4500 kg/ha
>1H to 1V	4500 lb/ac	5100 kg/ha
Below ECB or TRM	1500 lb/ac	1700 kg/ha
As infill for TRM	3500 lb/ac	3900 kg/ha

- b. Increase application rates on highly erosive soils or chiseled, disked, furrowed or tracked slopes. Contact Manufacturer for additional details.
- c. Material should not be applied in channels, swales or other areas where concentrated flows are anticipated, unless installed in conjunction with a temporary erosion control blanket or non-degradable turf reinforcement mat.
- d. After application, thoroughly flush the tank, pumps and hoses to remove all FGM material. Wash all material from the exterior of the machine and remove any slurry spills. FGM will be more difficult to remove once it dries.

B. CLEANING AND PROTECTION

- 1. Clean spills promptly. Advise OWNER of methods for protection of treated areas. Do not allow treated areas to be trafficked or subjected to grazing

3.06 MULCHING

- A. Mulch materials, meeting the requirements of Part 2 of this Specification Section, shall be applied at the rate of 2 tons per acre.
- B. The mulch shall be stabilized by running a "weighted" disk harrow with disks set straight, over the area on the contour, after the mulch has been applied, so as to imbed or press a part of the straw into the soil sufficiently to hold it in place. On earth embankments or areas too steep for use of mechanized equipment, the mulch shall be held in place by using small stakes and twine or other method acceptable to the ENGINEER. The blown-on bituminous treated straw mulch method of placing the mulch, as specified in Section **212.06.03, Method 2 of the Standard Specifications for Road and Bridge Construction of the Kentucky Transportation Cabinet Department of Highways** will be an acceptable placing method.
- C. Mesh, netting or other special protective cover shall be at locations as shown on the Drawings and shall be installed according to the manufacturer's recommendations.
- D. The use of a Flexible Growth Medium as noted in 3.05 above will be an acceptable alternative to the use of mulch.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section provides cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for structural components. Structural components included under this Specification include, but are not limited to, footings, foundation walls, slabs-on-grade, floor slabs, retaining walls, building and basin walls, and stairs. This Section also governs sidewalks.

1.02 SCOPE OF WORK

- A. Work Included: Provide all labor, material, equipment and services to complete all cast-in-place concrete work required by the Project, shown on the Drawings or herein specified.

1.03 RELATED WORK

- A. Earth and rock work - Section 02200.
- B. Crushed stone and dense graded aggregate (DGA) - Section 02235.
- C. Concrete paving - Section 02510.
- D. Foundation drainage - Section 02713.

1.04 CODES AND STANDARDS

- A. Conform to the following except as modified herein:
 - 1. ACI 318-08, "Building Code Requirements for Reinforced Concrete."
 - 2. Governing Building Code. Comply with all requirements of the Kentucky Building Code, 2013 edition.
 - 3. ACI SP-15, Field Reference Manual. A copy of this publication must be kept in the field office at all times during concrete construction.
 - 4. ACI 304, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
 - 5. ACI 311, Recommended Practice for Concrete Inspection.
 - 6. ACI 211.1 Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete.
 - 7. ACI 214, Recommended Practice for Evaluation of Compression Test Results of Field Concrete.
 - 8. ACI 117, Specifications for Tolerances for Concrete Construction and Materials.
 - 9. ACI 301, Specifications for Structural Concrete.

10. ACI 305, Recommended Practice for Hot Weather Concreting.
11. ACI 306, Recommended Practice for Cold Weather Concreting.
12. ACI 308, Recommended Practice for Curing Concrete.
13. ACI 309, Recommended Practice for Consolidation of Concrete.
14. AASHTO M 182, Burlap Cloth Made from Jute or Kenaf.
15. All materials intended for use in contact with water during or after treatment process must carry NSF 61 certification, as applicable.

- B. All work shall be performed to secure for the entire job homogeneous concrete having required strength, durability and weathering resistance, without planes of weakness and other structural defects and free of pronounced honeycombs, air pockets, voids, projections, offsets of plane, and other defacements on exposed surfaces.

1.05 SUBMITTALS

- A. In order to establish compliance with these Specifications, provide the following submittals and material certificates, as applicable:
1. Mill tests for cementitious materials.
 2. Admixture certification. Concrete admixtures product data shall include brand name and manufacturer and dosage rate.
 3. Aggregate certification and gradation.
 4. Concrete mix designs and laboratory test results of similar mix design, if requested by ENGINEER.
 5. Construction and control joint plan and joint-filler strips.
 6. Method of developing bond at joints and dowel bar replacements, if desired or specified.
 7. Form materials and form-release agents.
 8. Waterstops.
 9. All concrete reinforcement, including deformed steel reinforcement, welded wire fabric, synthetic fiber reinforcement, and all associated accessories.
 10. Materials and methods for curing, including curing compounds.
 11. Floor and slab treatments, bonding agents, adhesives, vapor retarders, repair materials, and any additional materials, as needed to establish compliance.
- B. Shop drawings for reinforcing steel and accessories prepared in accordance with "Details and Detailing of Concrete Reinforcement," ACI 315.
1. Submit placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, materials, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connectors, tie spacing, hoop spacing, and supports for concrete reinforcement.

- C. In order to establish compliance with these Specifications and demonstrate appropriate ability to perform, provide the following information for the proposed source of ready-mixed concrete.
 - 1. Physical capacity of mixing plant.
 - 2. Trucking facilities available.
 - 3. Estimated average amount which can be produced and delivered to the site during a normal 8 hour day, excluding the output to other customers.
- D. Manufacturer's Data: For information only and as requested by the ENGINEER, submit 2 copies of manufacturer's data with application and installation instructions for all proprietary materials, as applicable.
- E. Substitutions: Any request for product substitution must be submitted for review, with all necessary documentation, prior to time of bid. No requests for substitutions will be considered after bid has been received.
- F. Throughout the Specifications, types of materials may be specified by manufacturer's name in order to establish standards of quality and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the Bidder may assume the phrase "or approved equal," except that the burden is upon the Bidder to prove such equality. If the Bidder elects to prove such equality, it must request the ENGINEER's approval in writing to substitute such item for the specified item, with data and samples, if required, to permit a fair evaluation of the proposed substitute with respect to quality, serviceability, warranty and cost.
- G. Delivery Tickets: Furnish to ENGINEER copies of all delivery tickets for each load of concrete delivered to the site.
- H. Floor flatness and levelness measurements to determine compliance with specified tolerances.

1.06 COORDINATION

- A. Review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete.
- B. Notify other contractors in advance of the placing of concrete to provide the other contractors with sufficient time for furnishing of items included in their contracts that must be installed in the concrete. The CONTRACTOR is responsible in the event that planned embedded items, penetrations, or other features are omitted from the cast concrete structure. Notify ENGINEER immediately if such an error is made. ENGINEER will approve the corrective action, up to and including complete removal and replacement. The approved corrective action is to be performed at no additional cost to OWNER.
- C. CONTRACTOR shall coordinate work to allow the independent testing agency to do their work.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on the Project personnel qualified as ACI-certified flatwork technician and finisher and a supervisor who is an ACI-certified concrete flatwork technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Source Limitations: Obtain each type of class or cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code—Reinforcing Steel."
 - 1. Field-welding of reinforcing steel will only be allowed by prior written approval from the ENGINEER.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General
 - 1. All concrete shall be ready-mixed and all components shall be added at the batch plant according to the approved concrete mix design.
 - 2. After award of the Contract, the CONTRACTOR shall submit in writing to the ENGINEER the name, address and qualifications of the ready-mix supplier who will furnish concrete for the project. The CONTRACTOR shall also submit the supplier and source of the sand, coarse aggregate, cement and admixtures.
 - 3. Each material submitted for tests shall be from the same single source as material proposed for the concrete work unless otherwise required or permitted.

4. Also refer to ACI 301 and Supplemental Requirements under PART 3 - EXECUTION, this Section.

B. Cement and Cementitious Materials

1. Definition of Cementitious Materials: Portland cement alone or in combination with one or more of the following: Blended hydraulic cement, fly ash, and other pozzulans, ground granulated blast-furnace slag and silica fume, subject to compliance with requirements.
2. Portland cement for concrete and mortar shall conform to ASTM C 150, Type I or II. Type V cement shall be used where indicated to provide sulfate resistance.
3. Type F fly ash is allowable in quantities not to exceed a 20 percent replacement of cement. Comply with ASTM C 595 and C 618.
4. Silica Fume: Include where specified, in accordance with ASTM C 1240, amorphous silica. Where specified for use, do not exceed a 10 percent replacement of cement.
5. The CONTRACTOR shall deliver cementitious materials as requested by the ENGINEER to the testing laboratory for initial and periodic tests. Materials shall be delivered in a minimum amount of 1 sack at a time.
6. The ENGINEER may require the CONTRACTOR to deliver cement to the testing laboratory for tests according to ASTM Specification C 150 for Type I or II. Should cement fail the tests, the CONTRACTOR shall pay for the tests and the ENGINEER shall have the right to reject the brand.
7. Cement for tests shall be delivered in 4-ply paper bags with supplier and source identified in writing. Cement shall be stored in a dry location for not longer than 90 days after delivery from the mill.

C. Admixtures

1. Air-entraining admixture shall conform to ASTM C 260.
 - a. MasterAir AE 200 by BASF, Darex II AEA by Grace, Daravair 1400 by Grace, Sika AER by Sika, or approved equal.
2. Water-reducing admixture shall conform to ASTM C 494, Type A.
 - a. MasterPolyheed 1020 by BASF, Eucon X-15 by Euclid, or approved equal.
3. The water-reducing, set-retarding admixture shall conform to ASTM C 494, Type D.

- a. Eucon WR by Euclid, MasterPozzoloth 200 by BASF, or approved equal.
4. High range water reducing admixture (superplasticizer) shall conform to ASTM C-494, Type F or G.
 - a. ADVA 190 by Grace, Eucon 37 by Euclid, or approved equal.
5. Accelerating admixture shall conform to ASTM C-494, Type C.
 - a. MasterSet AC122 by BASF, Daraset 400 by Grace, or approved equal.
6. The admixture manufacturer shall furnish a qualified concrete technician employed by the manufacturer, to assist in the proper batching and use of specified admixtures. The technician shall visit the batch plant as requested during construction. In addition, the manufacturer shall furnish the ready mix plant with accurate and dependable equipment for the proper dispensing of admixture.
7. Substitute admixtures will be acceptable provided they meet or exceed all properties of the specified materials and specified field service is provided.
8. The CONTRACTOR shall deliver upon request, to the testing laboratory selected by the OWNER, 12 fluid ounces of each admixture required in the concrete design mix. Admixture samples shall be labeled with printed identification indicating trade name, strength, dosage instructions and manufacturer.
9. All admixtures shall be approved by the cement manufacturer.
10. All admixtures shall be non-chloride and non-corrosive. Admixtures shall have documentation stating that they do not contribute to the corrosion of steel reinforcement in concrete.

D. Water

1. Mixing water for concrete shall meet requirements of ASTM C94.
2. Water shall be clean and free from injurious amounts of oils, acid, alkali, organic matter, or other deleterious substances.
3. When subjected to the mortar strength test described in ASTM C 87, the 28-day strength of mortar specimens made with the water under examination and normal portland cement shall be at least 100 percent of the strength of similar specimens made with distilled water.
4. Potable tap water will normally fulfill the above requirements.

F. Fine Aggregate

1. Fine aggregate shall consist of clean, well graded particles of hard, durable sand and shall contain limited amounts of deleterious substances. It shall be washed Ohio, Scioto, or Cumberland River sand. Most Tennessee River sand, bank sands, and limestone fines are not acceptable. Manufactured sand is not acceptable.
2. The CONTRACTOR shall deliver sand as requested by the ENGINEER to the testing laboratory for initial and periodic tests. Usually 150 pounds of sand for initial and periodic tests will be sufficient. All material delivered to the laboratory shall be accompanied by identification in writing as to supplier and source.
3. Sand shall be graded in accordance with Section 804 of the Kentucky Transportation Cabinet, Department of Highways Standard Specifications for Road and Bridge Construction.

	<u>Percent</u>
Passing 3/8 Inch Sieve	100
Passing No. 4 Sieve	90-100
Passing No. 16 Sieve	45-85
Passing No. 50 Sieve	5-25
Passing No. 100 Sieve	0-8

4. Sand shall meet the requirements of these Specifications and the specifications and tests listed below:

Deleterious Substances	- Par. 5 - ASTM Designation C 33.
Soundness	- Par. 6 - ASTM Designation C 33.
Organic Impurities	- ASTM Designation C 40.

G. Coarse Aggregate

1. Coarse aggregate shall be washed river gravel or crushed limestone of hard durable particles and shall contain limited amounts of deleterious substances. Crushed limestone shall come from ledges of a quarry approved by the Kentucky Transportation Cabinet, Department of Highways for use in reinforced concrete untreated bridge superstructures above the tops of the caps, excluding pedestals.
2. The CONTRACTOR shall deliver coarse aggregate as requested by the ENGINEER to the testing laboratory for initial tests and periodic tests. Usually 200 pounds of coarse aggregate for initial and periodic tests will be sufficient. All material delivered to the laboratory shall be accompanied by identification in writing as to supplier and source.

3. Coarse aggregate shall be graded in accordance with Section 805 of the Kentucky Transportation Cabinet, Department of Highways Standard Specifications for Road and Bridge Construction. Refer to Section 3.6 of ACI 301 for maximum size of coarse aggregate.

	<u>Percent by Weight</u>	
	<u>No. 57</u>	<u>No. 67</u>
Passing 1-1/2 Inch Square Sieve	100	
Passing 1-Inch Square Sieve	95-100	100
Passing 3/4-Inch Square Sieve	-	90-100
Passing 1/2-Inch Square Sieve	25-60	-
Passing 3/8-Inch Square Sieve	-	20-55
Passing No. 4 Square Sieve	0-10	0-10
Passing No. 8 Square Sieve	0-5	0-5

4. Coarse aggregate shall meet the requirements of these Specifications and the specifications and tests listed below:

Deleterious Substances	- Par. 9 - ASTM Designation C 33.
Soundness	- Par. 9 - ASTM Designation C 33.
Abrasion	- Par. 9 - ASTM Designation C 33.

H. Reinforcing

1. Unless otherwise required or permitted, concrete reinforcing bars shall conform to grade 60 deformed bars and shall meet requirements of Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (ASTM A 615). All other reinforcement and details shall conform to ACI Standard Building Code Requirements for Reinforced Concrete (ACI 318).
 - a. Recycled content of steel products: Provide products with an average recycled content of steel products so postconsumer recycled content plus 1/2 of pre-consumer recycled content is 25 percent, minimum.
2. Before steel is shipped to job, the reinforcing steel supplier shall submit to the ENGINEER, 2 certified copies of mill tests on all steel to be used in the work. The tests shall substantiate that chemical and physical properties of the steel comply with the requirements of the governing specification.
3. The ENGINEER may require the CONTRACTOR, at his expense, to deliver samples of reinforcing steel to the testing laboratory, to determine compliance with governing specifications. Should the reinforcing steel fail the tests, the CONTRACTOR shall pay for the tests and the ENGINEER shall have the right to reject the entire shipment of steel.

4. The CONTRACTOR shall carry in stock at beginning of concrete work the following amounts of extra reinforcing steel for replacement of lost steel or additional steel considered necessary by the ENGINEER:

5 - #3 Bars	30 Feet - 0-Inch Long
5 - #4 Bars	30 Feet - 0-Inch Long
5 - #5 Bars	30 Feet - 0-Inch Long

5. Welded wire fabric shall be new steel wire fabric, conforming to ASTM A185, and welded in a rectangular pattern.
6. Tie wire for reinforcement shall be 16 gauge or heavier, black or galvanized steel wire, conforming to ASTM A82.
7. Joint dowel bars shall be ASTM A615, Grade 60, cut true to length with ends square and free of burrs.
8. Bar supports, bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement shall be used. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
9. Synthetic fiber reinforcement where required, shall be fibrillated polypropylene fibers, engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
10. Dowel bar replacements may be allowable on a case-by-case basis, per ENGINEER'S approval.

I. Non-shrink Grout

1. Unless otherwise required or permitted, the grout for non-shrink waterproof joints, waterproof mortar patches, filling under handrail floor flanges and anchoring bolts into existing concrete shall be Quikrete Commercial Grade FastSet, Master Builders' Masterflow 713 grout, or equal. The grout for use under baseplates of columns, pumps, compressors, generators and similar heavy equipment, and for rebar grouting shall be Sonneborn-Contech FerroLith GNC, Master Builders' Embeco 636 grout, or equal.

J. Waterstop for Construction and Control Joints

1. Unless otherwise shown, waterstops where indicated on the Drawings, shall be 6 inches wide, 3/16-inch minimum thickness, ribbed with center bulb, virgin polyvinyl chloride, in accordance with Corps of Engineers Specifications CRD-C-572, latest revision, as manufactured by Greenstreak, Inc., Vinylex Corp., or equal.

2. Where metal waterstops are required, they shall be fabricated from nickel-copper roofing sheet conforming to the requirements of ASTM B 127-85 and shall be No. 24-gauge U.S. Standard (0 to .025-inch) thick with widths as shown on the project Drawings. Waterstops shall be prefabricated to fit the contour of the joints and shall be folded, bent and/or crimped in accordance with details shown or accepted. Bends and crimps shall be made with a minimum radius of 1/2-inch. All joints shall be lapped and pre-tinned at least 1 inch, riveted and soldered, to make the stops continuous and watertight. Solder shall be a minimum of 50 percent tin and the remainder lead. Rivets shall be nickel-copper alloy conforming to the requirements of ASTM B 164, Class A.
3. Waterstops shall be furnished in maximum lengths available to reduce the number of joints to the minimum.
4. Provide factory fabrications for all intersections, transitions and changes of direction, leaving only straight butt joint splices for the field.
5. Self-expanding rubber strip waterstops, where required, shall be manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8-inch x 3/4-inch.

K. Premolded Joint Fillers

1. Joint fillers, where required, shall be foam expansion joint filler (closed cell, ultraviolet stable, polyethylene foam), asphalt-saturated cellulosic fiber (ASTM D 1751) or cork (ASTM D 1752). Where the application requires cementing the joint filler into place, such as in a wall expansion joint, a pressure-sensitive adhesive recommended by the filler manufacturer shall be used.

L. Concrete Floor Curing and Sealing System

1. System shall be a pigmented, ready to use, non-yellowing, acrylic curing and sealing compound which seals by providing a tough scuff resistant film over freshly finished concrete and complies with ASTM C309. System shall be Sonneborn-Contech's Gray Kure-N-Seal, the Euclid Chemical Company's Diamond Clear VOX, or W.R. Meadow's Sealtight 1100, Vexcon Chemicals' Starseal 800, or approved equal.

M. Concrete Joint Sealant

1. Horizontal Joints: Self-leveling Floor, Deck, and Sidewalks
 - a. One-part self-leveling polyurethane sealant for concrete floors, decks, sidewalks and other horizontal contraction and expansion joints shall be Sonolastic SL1 as manufactured by Sonneborn-Contech or equivalent by W.R. Grace Company or equal.

- b. Sealant shall comply with Federal Specification TT-S-00230C, Type 1 Class A and ASTM C 920-79, Type S, Grade P, Class 25, Use T, M. Joint primer shall be Sonolastic primer No. 733. When required in deep joints, backing material shall be Sonofoam Backer-Rod which should not be primed and/or punctured.
 - c. Sealant color shall be limestone or gray as selected by the ENGINEER unless otherwise required or permitted.
- 2. Vertical Joints: Sealants and Backing
 - a. For sealing vertical exposed faces of joint fillers, use Sonneborn-Contech Sonolastic NP1 or NP2 (one or two component urethane) or equivalent W.R. Grace Co. products, or equal. For water immersion, prime with Sonneborn-Contech Primer No. 733 for concrete and masonry or Primer No. 758 for glass and metals or as required by manufacturers of equivalent acceptable sealants.
 - b. For sealing horizontal exposed faces of joint fillers, use Sonneborn-Contech Sonolastic SL1, one-part, self-leveling, polyurethane sealant with Primer No. 733 or equivalent W.R. Grace Co. products, or equal.
 - c. Where additional sealant backing is needed to control the depth of sealant in relation to joint width, use Sonneborn-Contech Sonoflex F foam expansion joint filler or Sonofoam Backer Rod (closed cell polyethylene foam) or equivalent W.R. Grace Co. products or equal.

N. Bonding Agent

- 1. For General Applications: Provide ASTM C 1059, Type II, nonredispersible, acrylic emulsion, or styrene butadiene.
- 2. For Humid Conditions or Damp Surfaces: Provide an epoxy-resin bonding agent, 2 component, complying with ASTM C881, of class suitable for application temperature and of grade to suit requirements, provide Type IV or V.

O. Patching Mortar

- 1. Use free flowing, polymer modified cementitious mortar, "Euco Thin Coat, Concrete Coat" (horizontal repairs), "verticoat" (vertical and overhead repairs) by the Euclid Chemical Company or "Sikatop 121 or 122" (horizontal repairs), "Sikatop 123" (vertical and overhead repairs) by Sika Chemical Corp.
- 2. For Horizontal Applications: Provide polymer and microsilica modified cementitious repair and overlay mortar, design for use as a floor or deck topping at thicknesses 1/16 to 3/8 inches. Product shall have minimum compressive strength of 5,000 psi at 28 days, when tested in accordance

with ASTM C 109. Provide Thin-Top Supreme by Euclid, or approved equal.

3. For Vertical and Overhead Applications: Provide 2-component, trowel-grade, polymer-modified cementitious mortar designed for use in vertical and overhead concrete repairs. Product shall have minimum compressive of 5,000 psi at 28 days when tested in accordance with ASTM C 109. Provide Verticoat by Euclid, or approved equal.

P. Form-Facing Materials

1. 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.
 - a. Plywood, metal, or other approved panel materials.
2. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
3. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - a. Furnish units that will leave no corrodible metal closer than 3/4-inch to the plane of exposed concrete surface.

Q. Vapor Retarders

1. Plastic Vapor Retarder shall be ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

PART 3 EXECUTION

3.01 CONCRETE BATCHING AND MIXING

- A. Concrete for all parts of the work shall be of the specified quality and shall be placed without excessive segregation. When hardened, concrete shall develop all characteristics required by these specifications.
- B. The specified compressive strength of the concrete (f'c) for each portion of the structure shall be as designated in the contract documents. Strength requirements shall be based on 28-day compressive strength.

- C. All efforts shall be made to provide for each structure concrete which meets these specifications, results in a homogeneous structure, with consideration given to the specific application and purpose.
- D. Unless otherwise noted, light-weight concrete shall not be allowed.
- E. Concrete proportions shall be established on the basis of previous field experience or laboratory trial batches, and to satisfy the following requirements:
 - 1. Footings, foundation walls, retaining walls, reinforced beams and columns: Proportion normal-weight concrete mixture as follows:
 - a. Minimum compressive strength ($f'c$) = 4,000 psi
 - b. Maximum water-cementitious material (w/cm) ratio = 0.45
 - c. Slump Limit: 3 inches +/- 1 inch. If a high-range water-reducing admixture is used, limit is increased to 8 inches +/- 1 inch.
 - d. Air Content: 4.5 to 7.5 percent at point of delivery for #57 coarse aggregate, 5.0 to 8.0 percent at point of delivery for #67 coarse aggregate.
 - 2. Slabs-on-Grade, Floor Slabs, and Equipment Pads: Proportion concrete mixture as follows:
 - a. Cement Type: Use Type II cement
 - b. Minimum compressive strength ($f'c$) = 4,000 psi
 - c. Maximum water-cementitious material (w/cm) ratio = 0.45
 - d. Slump Limit: 4 inches +/- 1 inch.
 - e. Air Content: 3.5 to 6.5 percent at point of delivery. Do not allow air content of troweled finished floors to exceed 3 percent.
 - f. Synthetic Fibers: Option only if directed or approved by the ENGINEER. Uniformly disperse in concrete mixture at the time of batching. Provide the manufacturer's recommended dosage rate, but not less than 1.5 lb/cu yd.
 - 3. Reinforced portions of manholes, sidewalks and piers: Proportion concrete mixture as follows:
 - a. Minimum compressive strength ($f'c$) = 4,000 psi
 - b. Minimum cementitious materials content = 550 lb/cu yd
 - c. Slump Limit: 3 to 4 inches, unless a high-range water reducing admixture is used.

4. Non-reinforced portions of manholes and pipe cradles: Proportion concrete mixture as follows:
 - a. Minimum compressive strength ($f'c$) = 3,500 psi
 - b. Minimum cementitious materials content = 520 lb/cu yd
 - c. Slump Limit: 3 to 4 inches, unless a high-range water reducing admixture is used.
5. Kickers for pipe and fittings: Proportion normal-weight concrete mixture as follows:
 - a. Minimum compressive strength ($f'c$) = 3,000 psi
 - b. Minimum cementitious materials content = 470 lb/cu yd
 - c. Slump Limit: 3 to 4 inches, unless a high-range water reducing admixture is used.
6. Encasement of sewer and sewer laterals: Proportion concrete mixture as follows:
 - a. Minimum compressive strength ($f'c$) = 2,500 psi
 - b. Minimum cementitious materials content = 450 lb/cu yd
 - c. Slump Limit: 3 to 6 inches.
7. Cradles or refill under conduits and fill under structures, as required: Proportion concrete mixture as follows:
 - a. Minimum compressive strength ($f'c$) = 2,000 psi
 - b. Minimum cementitious materials content = 360 lb/cu yd
 - c. Slump Limit: 3 to 6 inches.
- F. All structures designated to be watertight or subjected to potentially destructive exposure such as freezing and thawing, severe weathering or deicer chemicals shall have an entrained air content of 5 to 7 percent.
- G. All admixtures shall be used in accordance with the manufacturer's instructions.
- H. The ENGINEER may require a set-retarding admixture if required by construction conditions. Otherwise, admixtures shall be used according to the approved concrete mix design.
- I. Ready-mixed concrete shall be measured, batched, mixed and delivered according to ASTM C94 and ASTM C1116. Batch ticket information shall be furnished to the ENGINEER for each concrete delivery.

1. When air temperature is between 85 and 90 degrees Fahrenheit, reduce mixing and delivery time from 90 minutes to 75 minutes. When air temperature is above 90 degrees Fahrenheit, reduce mixing and delivery time to 60 minutes.
2. If concrete arrives at the job with slump below that which is suitable for placing, as specified, water may be added ONLY if neither the maximum permissible water-cementitious materials ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required.

3.02 FORMWORK

- A. Formwork is the responsibility of the CONTRACTOR and shop drawings are not required.
- B. 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.
- C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 1. Class A, 1/8-inch for smooth-formed finished surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent which effectively prevents the absorption of moisture, according to manufacturer's written instructions, before placing reinforcement.
- M. Earth cuts may be used as forms for footing vertical surfaces, at the discretion of the ENGINEER. For such approval, sides shall be sharp and true, and not exposed in the finished structure.

3.03 EMBEDDED ITEMS

- A. All accessories and other items to be partially or wholly embedded in concrete, such as ties and hangers, shall be of a commercially manufactured type. Nonfabricated wire shall not be used. Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the surface of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 1-1/2 inch from the formed faces of concrete. Refer to ACI 347 for additional recommendations. Form ties shall have waterstops in all water- and sewage-holding basins and in all dry rooms below ground or below high water levels and in additional places noted on the Project Drawings unless otherwise required or permitted.
- B. 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.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install dovetail anchor slots in concrete structures as indicated.
- C. Pipes shall not be poured or solidly grouted in concrete walls or floors unless fixations are indicated on the Project Drawings, for example as anchorage to resist pipe thrusts, unless otherwise required or permitted.
- D. At wall and slab penetrations, openings shall be formed approximately 1-inch greater than the OD of the pipe. After pipe placement and alignment adjustment, the annular space between opening and outside of pipe shall be packed with dry braided hemp (or unbraided where pipe does not center in openings) to within 2 inches of the wall or slab shrink grout or caulked as required or permitted with materials specified in Division 7 of these Specifications. If required by plans, the penetration shall be filled with a modular

seal, such as Link-Seal, or approved equal. Follow all manufacturer's recommendations.

- E. Sleeves shall be cast in floors and walls for penetrations of small pipe, cut and fitted on the job, such as steel, wrought iron, copper, plastic and rubber pipe and hoses. Unless otherwise required or permitted, sleeves shall be steel, cast iron, or plastic of about 1-inch greater ID than the OD of the pipe and shall be packed and grouted or caulked as previously described, except the joint depth shall be 1-inch and, if required or permitted, hemp packing may be replaced with backer rod and joint sealant according to Division 7 of these Specifications. Penetrations may be made by coring if permitted by the ENGINEER.
- F. Where openings larger than 10 inches in diameter are required for pipe penetration in existing walls and slabs, the opening shall be made approximately 2 inches to 4 inches larger in diameter than the pipe OD.
- G. All joints around pipe shall be watertight unless otherwise required or permitted.

3.04 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 degrees Fahrenheit for 72 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained. Formwork which supports the weight of concrete members shall remain in place until the concrete has reached 75 percent of the specified strength.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by ENGINEER.

3.05 VAPOR RETARDERS

- A. All subgrades shall be covered with a polyethylene vapor retarder as specified herein. Joints shall be lapped a minimum of 12 inches unless otherwise required or permitted.
- B. Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions. Seal joints with manufacturer's recommended tape.

3.06 STEEL REINFORCEMENT

- A. 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.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement prior to placement of concrete. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Placing reinforcement of the ground and pulling up after concrete placement will not be allowed in any case. Floating reinforcement will not be allowed.

3.07 JOINTS

- A. 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, at locations indicated or as approved by ENGINEER.
 - 1. Plate Dowels: Where indicated on the plans, include plate dowel systems by PNA Technologies, or approved equal. Pocket formers are to be installed in first concrete placement, with the plate dowels installed for the subsequent placement. Plates shall be 1/4-inch x 4-1/4 inch x 4-1/4 inch, per Diamond Dowel System by PNA, or approved equal.
- C. Contraction Joints in Slabs-on-Grade (Control Joints): Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.08 WATERSTOPS

A. PVC Waterstop

1. Install where indicated in accordance with manufacturer recommendations. Water stop shall be formed into place, typically within the keyway. See plans.

B. Self-Expanding Strip Waterstops

1. Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.09 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. It will typically not be permitted to add water to concrete during delivery, at Project site, or during placement. If the requirements of Section 3.01, Concrete Batching and Mixing, are satisfied, and with approval of ENGINEER, water may be added as follows.
 1. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 2. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. General: Place concrete continuously so that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation. If a section cannot be placed continuously, provide construction joints in accordance with the plan.
 1. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
 2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the job site and dispose of it in an acceptable location.
 3. Do not place concrete until all forms, bracing, reinforcement, and embedded items are in final and secure position.

4. Do not place footings in freezing weather unless adequate precautions are taken against frost action. See additional requirements herein.
5. Do not place footings, piers or pile caps on frozen soil.
6. Allow a minimum of 3 days before placing concrete against a slab or wall already in place.
7. Unless adequate protection is provided and acceptance is obtained, concrete shall not be placed during rain, sleet, or snow. Adequate protection prevents any and all adverse effects of the precipitation on the appearance, strength, and durability of the concrete.
8. Furnish 2 delivery tickets with each load containing the following information:
 - a. Date.
 - b. Product and plant.
 - c. Job name and location.
 - d. Truck number and time dispatched.
 - e. Concrete designation and cement type.
 - f. Admixtures description and content.
 - g. Time discharge started and completed.
 - h. Amount of concrete in load.
 - i. Where a ready-mix concrete supplier has more than one batch plant, make all deliveries from the same plant.
9. The concrete must be discharged from the ready-mix trucks within 1-1/2 hours after the introduction of mixing water to the cement and aggregates. Arrange the delivery so that intervals between batches are kept to a minimum, and in any event not more than 30 minutes. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. See Section 3.01 of this specification for additional information in this regard.
10. Placement of concrete underwater shall be allowed only by permission of the ENGINEER unless otherwise required or permitted.

D. Concrete Conveying

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.

2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.
3. Do not use chutes for distributing concrete unless approved in writing by ENGINEER.
 - a. Provide sketches showing methods by which chutes will be employed when requesting such approval.
 - b. Design chutes, if permitted, with proper slopes and supports to permit efficient handling of the concrete.
4. Pumping concrete is permitted, however, do not use aluminum pipe for conveying.

E. Placing Concrete into Forms

1. Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
2. Do not permit concrete to free fall within the form a distance exceeding 4 feet. Use "elephant trunks" to prevent free fall and excessive splashing on forms and reinforcement.
3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with the applicable recommended practices of ACI 301 and ACI 309. Vibration of forms and reinforcing will not be permitted, unless otherwise accepted by ENGINEER.
5. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

6. Do not place concrete in beam and slab forms until the concrete previously placed in columns and walls is no longer plastic.
7. Force concrete under pipes, sleeves, openings, and inserts from one side until visible from the other side to prevent voids.

F. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures.
5. Screed slab surfaces with a straightedge and strike off to correct elevations. Slope surfaces uniformly to drains where required. Smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess bleedwater appears on the surface. Do not further disturb the slab surfaces prior to beginning finishing operations.

G. Bonding for Next Concrete Pour

1. General: Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent or noted otherwise. Clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and to not leave laitance, loose particles of aggregate, or damaged concrete at the surface.
2. Bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:
 - a. Thoroughly wet the surface but allow no free standing water.
 - b. For horizontal surfaces place a 1 to 2 inch layer of mortar, 1 part sand and 1 part cement with water, over the hardened concrete surface.
 - c. Place fresh concrete before the mortar has attained its initial set.

3. Bonding of fresh concrete to fully-cured hardened concrete or existing concrete shall be accomplished by using an epoxy-resin bonding agent as specified.

H. Quality of Concrete Work

1. Make all concrete solid, compact and smooth, and free of laitance, cracks, and cold joints.
2. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
3. Cut out and properly replace to the extent ordered by the ENGINEER, or repair to the satisfaction of the ENGINEER, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Thin patches or plastering will not be acceptable.
4. All leaks through concrete, and cracks, holes or other defective concrete in areas of potential leakage, shall be repaired and made watertight by CONTRACTOR.
5. Repair, removal, and replacement of defective concrete as ordered by ENGINEER shall be at no additional cost to OWNER.

I. Cold Weather Concreting

1. General: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. The provisions of ACI 306 shall be followed for all concrete placed or cured when the average daily temperature is below 40 degrees Fahrenheit for 3 successive days. The methods of protection used for cold weather concreting shall be submitted in writing to the ENGINEER for review at least one week prior to cold weather placement.
3. Plan construction schedule and obtain needed materials and equipment on the project site in advance of cold weather.
4. All reinforcement, form work and subgrades shall be clear of ice and snow and be above 40 degrees Fahrenheit at time of placement of concrete.
5. Concrete temperature as discharged shall not be less than 50 degrees Fahrenheit nor greater than 70 degrees Fahrenheit. The temperature of the concrete being discharged shall be tested by the testing agency.
6. The CONTRACTOR shall provide, install, and read maximum/minimum thermometers during the construction and curing of all structural slabs in cold weather. Provide one thermometer for each 3000 square feet of a

slab. Place the thermometer near slab perimeter. The CONTRACTOR shall submit those temperature readings to the ENGINEER weekly.

7. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

J. Hot Weather Concrete

1. General: During periods of high air temperature, low relative humidity, or high wind velocity, measures shall be taken to protect concrete from being adversely impacted.
2. The provisions of ACI 305 shall be followed for all concrete placed when the air and/or form temperature is greater than 90 degrees Fahrenheit. Note: Concrete protection during windy conditions combined with hot and/or low humidity shall also conform to ACI 305. The methods of protection used for hot weather concreting shall be submitted in writing to the ENGINEER for review at least one week prior to hot weather placement.
3. Plan construction schedule and obtain needed materials and equipment on the project site in advance of hot weather.
4. CONTRACTOR and ready mix producer shall review concrete mixes for use in hot weather with respect to placing requirements, strength and durability.
5. Concrete temperatures as discharged from the truck shall not exceed 85 degrees Fahrenheit. Ice, if used, shall be considered part of the total mix water (50 lbs ice = 6 gallons of water). Retarders in low slump superplasticized mixes may be required to comply with this requirement. Using liquid nitrogen to cool concrete is CONTRACTOR'S option. The temperature of the concrete being discharged shall be tested by the testing agency.
6. Cool and moisten form work and subgrade by sprinkling with water or fog-spraying prior to placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
7. Placement and Finishing
 - a. Concrete shall be discharged from the truck a maximum of one hour after the introduction of mix water to cement and aggregates.
 - b. Strike off and screed slabs immediately. Protect slab's surface against moisture loss prior to final finishing.
 - c. Cure as specified in ACI 301 and herein.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Fins exceeding 1/4-inch in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.
 - 1. Apply to concrete surfaces which are not exposed to the view of the public or to the view of personnel responsible for operation or maintenance of the facilities.
 - 2. Covered under this category shall be surfaces similar to and inclusive of inside surfaces of covered vaults, covered intake structures, covered clearwells and covered basins; surfaces 2 feet and greater below operating liquid level in open basins; surfaces in contact with fills and 1 foot or greater below the top of fills ; and any additional surfaces required or permitted.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, producing a smooth, hard, uniform texture on the concrete. Form-facing material may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other acceptable material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.
 - 1. Smooth form finish shall be used on all surfaces not included in Section A above unless otherwise required or permitted.
- C. Grout Cleaned Finish: Mix 1 part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having the consistency of thick paint. White Portland cement shall be substituted for a part of the gray Portland cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with brushes or a spray gun. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, burlap, or other means. After the surface whitens from drying (about 30 minutes at normal temperature), rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.
 - 1. No cleaning operations shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible.

2. Cleaning as the work progresses shall not be permitted.
 3. Grout-cleaned finish shall be applied to all smooth form finish surfaces unless otherwise required or permitted.
 4. Grout-cleaned finish shall be undertaken as soon as forms can be removed without jeopardizing the structure and after necessary patching has been completed. In order to insure continuity of color and texture, grout cleaned finish shall be applied at one time to continuous, plane, surfaces such as from corner-to-corner to a wall.
- 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.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
1. Apply scratch finish to surfaces indicated to receive scratch finish.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated to receive roofing, waterproofing membrane, or sand bed terrazzo, and where indicated.
- D. 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 on which water and sewage flow and to all surfaces normally intended as walking surfaces, including surfaces to receive covering such as tile, and in working areas, except as required for non-slip surfaces.
 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) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade and floor slab.
- 3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8-inch.
- E. Broom or Belt Finish: Apply a broom or belt finish to exterior concrete sidewalks, platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route, maintaining the required surface tolerance to provide non-slip finish.
- F. Refer to project drawings for any special requirements.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases: Unless specifically shown otherwise, provide concrete bases for all pumps and other equipment. Construct bases as required to meet manufacturers' requirements and Drawing elevations. Where no specific elevations are shown, bases shall be 6 inches thick, and extend 3 inches outside the metal equipment base or supports. Bases shall have smooth trowel finish, unless a special finish such as terrazzo, ceramic tile or heavy duty concrete topping is required. In those cases, provide appropriate concrete finish.
 - 1. Include all concrete equipment base work not specifically included under other Sections or other contracts.
 - 2. In general, place bases up to 1-inch below the metal base. Properly shim equipment to grade and fill 1-inch void with non-shrink grout.
- C. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded or chamfered as required.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Scream, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 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 7 days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure and use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 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 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- 4. Curing and sealing compound shall be applied uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- F. Masonry shall not be placed on or supported off of structural floors until the concrete has achieved full specified strength and all shores have been removed.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions where indicated in plans.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 3 days old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

3.16 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.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing. Substitute white cement for a portion of gray cement to match the surrounding concrete, as necessary.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, holes left by tie rods and bolts, and voids more than 1/4-inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by ENGINEER.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

5. Repair defective areas, except random cracks and single holes 1/4 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Cracks which require repair shall be pressure grouted using one of the following. Apply in accordance with the manufacturer's directions and recommendations. Acceptable products include Sikadur Hi-Mod L.V. and Gel by Sika Chemical Company, Euco Epoxy #452 and #461 by the Euclid Chemical Company, or approved equal.
 - F. Fill holes extending through concrete by means of a plunger-type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure completely filling.
 - G. Sandblast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.
 - H. Perform structural repairs of concrete, subject to ENGINEER's approval, using epoxy adhesive and patching mortar.
 - I. Repair materials and installation not specified above may be used, subject to ENGINEER's approval.
 - J. Ensure that surface is acceptable for flooring material to be installed in accordance with manufacturer's recommendations.

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspections: OWNER will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. The agency will meet the requirements of ASTM C1077 and the field technicians will be ACI Concrete Field Testing Technician, Grade I, or equivalent.
- B. Inspections
 1. Steel reinforcement placement.

2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each truck. Do not allow concrete to be placed that does not satisfy air entrainment requirements. The second or third truck every day shall have air content checked at both truck discharge and end-of-hose for pumped concrete.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees Fahrenheit and below and when 80 degrees Fahrenheit and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure 4 standard cylinder specimens for each composite sample.
 - b. Cast and field cure 2 standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39;
 - a. Test one field-cured specimen at 7 days and one set of two laboratory specimens at 28 days.
 - b. One laboratory specimen shall be retained in reserve for later testing as required.
 8. When strength of field-cured cylinders is less than 95 percent of companion laboratory-cured cylinders, CONTRACTOR shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified minimum 28 days compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 10. Test results shall be reported in writing to ENGINEER, concrete manufacturer, and CONTRACTOR within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by ENGINEER.
 12. Additional testing and inspecting, at CONTRACTOR'S expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. When there is evidence that the strength of the in-place concrete does not meet specification requirements, CONTRACTOR shall employ at his expense the services of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination. Test shall comply with ASTM C 42 and the following:
1. Take at least 3 representative cores from each member to suspect area at locations directed by ENGINEER.

2. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent and no single core is less than 75 percent of the 28-day required compressive strength.
 3. Report test results in writing to ENGINEER on the same day that tests are made. Include in test reports the project identification name and number, date, name of CONTRACTOR, name of concrete testing service, location of test core in the structure, type of class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of the concrete as placed, and the moisture condition of the core at time of testing.
 4. Fill core holes solid with patching mortar, and finish to match adjacent concrete surface.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION

SECTION 03301

**CAST-IN PLACE CONCRETE
(MINOR STRUCTURES)**

PART 1 GENERAL

1.01 SUMMARY

- A. This specification delineates the requirements for cast-in place concrete for minor structures including concrete kickers for pipe blocking, collars, manholes, manhole bottoms, pipe cradles, piers and other areas where small quantities of concrete are required. It shall not be used for major structures such as floor slabs, structure or basin walls, roof slabs, or other structural components.

1.02 SCOPE OF WORK

- A. Provide all labor, material, equipment and services to complete all cast-in-place concrete work required by the Project as shown on the Drawings or specified herein.

1.03 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	Specification for Steel, Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 497	Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 615/A615M	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 33	Specification for Concrete Aggregates
ASTM C 150	Specification for Portland Cement
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete

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1.04 SUBMITTALS

- A. Copies of all materials required to establish compliance with these Specifications shall be submitted in accordance with the provisions of the General Conditions.

1.05 QUALITY ASSURANCE

- A. All work shall be performed to secure for the entire job homogeneous concrete having required strength, durability and weathering resistance, without planes of weakness and other structural defects and free of pronounced honeycombs, air pockets, voids, projections, offsets of plane and other defacements on exposed surfaces.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver ready-mixed concrete to job site until ready for placement.
- B. All materials used for on-site mixed concrete shall be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer.
 - 1. In all cases, concrete materials shall be well-mixed prior to placement. No deviation from this requirement will be permitted.
- C. Store concrete aggregates to prevent contamination or segregation. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting.
- D. Protect from contaminants such as grease, oil and dirt. Provide for accurate identification after bundles have been broken and tags removed.

1.07 PROJECT/SITE CONDITIONS

A. Cold Weather

- 1. Provide and maintain 50 degrees Fahrenheit minimum concrete temperature. Do not place concrete when ambient temperature is below 40 degrees Fahrenheit. Cover concrete and provide with a source of heat sufficient to maintain 50 degrees Fahrenheit minimum while curing. Otherwise, comply with requirements of ACI 306, latest revision.

B. Hot Weather

- 1. Concrete temperature from initial mixing through final cure shall not exceed 90 degrees Fahrenheit. Cool ingredients before mixing, or substitute chip ice for part of required mixing water or use other suitable means to control concrete temperature to prevent rapid drying of newly placed concrete. Shade the fresh concrete and start curing as soon as the

surface is sufficiently hard to permit curing without damage. Otherwise comply with requirements of ACI 305, latest review.

PART 2 PRODUCTS

2.01 CONCRETE

A. Mix Design

The concrete mix shall conform to the requirements of the following table according to the class of concrete required. The number in the "Class" column refers to the 28-day compressive strength of the concrete in pounds per square inch (psi).

Class	Minimum Cement Content (Lbs./Cu. Yd.)	*Maximum Slump (Inches)
3000	470	3 to 4
3500	520	3 to 4
4000	550	3 to 4

* Maximum slump unless high range water reducing admixture is used.

B. Area of Application

1. Unless otherwise noted on the Drawings, concrete mixes shall be used as follows:

Class 3000 - kickers for pipe, fittings

Class 3500 - non-reinforced portions of manholes, pipe cradles

Class 4000 - reinforced portions of manholes, sidewalks, piers

2.02 MATERIALS

A. Cement and Cementitious Materials

1. Portland cement for concrete and mortar shall conform to ASTM C 150, Type I or II.
2. Type F fly ash is allowable in quantities not to exceed a 20 percent replacement of cement. Comply with ASTM C595 and C618. If fly ash is to be used, the concrete shall be ready-mixed.

B. Water

1. Water shall be potable.

C. Aggregates

1. Aggregates shall conform to ASTM C 33. Obtain aggregates from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.
2. Coarse aggregates shall be #57 or #67, graded in accordance with KYTC, Section 805.
3. Five aggregates shall be washed river sand, graded in accordance with KYTC, Section 804.

D. Admixtures

1. Admixtures for air-entrained concrete shall conform to ASTM C 260, for water reducing (Type A, D or E) accelerating (Type C) and retarding (Type B or D) ASTM C 494. Calcium chloride shall not be used as an admixture. Admixtures shall not be used without prior written approval of the ENGINEER.

E. Reinforcement

1. Reinforcing Bars
 - a. Reinforcing bars shall conform to ASTM A 615 Grade 60.
2. Welded Wire Fabric
 - a. Welded wire fabric shall conform to ASTM A 497 or ASTM A 185.

PART 3 EXECUTION

3.01 FORMS

- A. Forms shall be used to confine concrete and shape it to the required dimensions. Set forms true to line and grade and make mortar tight. Chamfer above grade exposed joints, edges and external corners 3/4-inch, unless otherwise indicated. Earth cuts may be used as forms for footing vertical surfaces, if sides are sharp and true, and not exposed in finished structure.

3.02 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

- A. Provide bars, wire fabric and other reinforcing materials, including wire ties, supports and other devices necessary to install and secure the reinforcement prior to placement of concrete.
- B. Placing reinforcement on the ground and pulling up after concrete placement will not be allowed in any case. "Floating" reinforcement will not be allowed.

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3.03 CONTROL AND CONSTRUCTION JOINTS

- A. For sidewalks, provide control joints spaced at an interval equal to the width of the sidewalk, the minimum spacing of 5 feet. Cut joints 1 inch deep with a jointing tool after the surface has been finished. Provide 0.5-inch thick transverse expansion joints at changes in direction, where sidewalk abuts curb, steps, rigid pavement or other similar structures; space joints not more than 40 feet apart. Limit variation in cross section to 1/4-inch in 5 feet.

3.04 CURING AND PROTECTION

- A. Protect concrete from injurious action by sun, wind, rain, flowing water or mechanical injury. Do not allow concrete to dry out from time of placement until the expiration of the curing period. Forms may be removed 48 hours after concrete placement.

END OF SECTION

SECTION 04200

UNIT MASONRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs) Load bearing and non-load bearing.
 - 2. Masonry joint reinforcement.
 - 3. Metal Furring Strips.
 - 4. Embedded flashing.
 - 5. Miscellaneous masonry accessories.
 - 6. Mortar / Cement
 - 7. Spray polyurethane foam insulation as applied to exterior wall cavities.
- B. Related Sections include the following:
 - 1. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
 - 2. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
 - 3. Division 01 Section "Allowances" for tuck pointing existing masonry joints.
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels and bond beams for unit masonry - see lintel schedule on structural drawings.

1.03 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells. See Reinforced Unit Masonry Specifications.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Standard: Provide components, supports and attachments designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 13.5, "Architectural Components"
 - 2. Provide components, supports and attachments that perform with the following seismic definitions:
 - 3. Seismic Design Category: See structural drawings.
 - 4. Site Class: See structural drawings.
 - 5. Building Classification 3
- B. Provide unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days as indicated in the structural drawings.
- C. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
 - 3. Reinforcing Steel: Detail Bonding and Placement of Unit Masonry Reinforcing comply with ACI 315.
- C. Samples for Initial Selection: For the following:
 - 1. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 2. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

- D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.
 5. Joint reinforcement.
 6. Anchors, ties, and metal accessories.
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602
- G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Preconstruction Testing Service: OWNER will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by OWNER.
1. Clay Masonry Unit Test: for each type of unit required, per ASTM C 67.

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2. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140
 3. Mortar Test (Property Specification): For each mix required, per ASTM C 780
 4. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019
- C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.
1. Build sample panels for a typical wall section in sizes approximately 60 inches long by 60 inches high by full thickness.
 2. Clean one-half of exposed faces of panels with masonry cleaner indicated.
 3. Protect approved sample panels from the elements with weather-resistant membrane.
 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until dry.

- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.08 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where 1 Wythe of multi-Wythe masonry walls is completed in advance of other Wythes, secure cover a minimum of 24 inches down face next to unconstructed Wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1.

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1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 2. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to, products specified.
 3. Products: Subject to compliance with requirements, provide one of the products specified
 4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, manufacturers specified.

2.02 MASONRY UNITS, GENERAL

- A. Defective Units / Quality: The referenced masonry unit standards contained herein may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Mason shall not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.
- B. Mason shall reject and not use (not place in exposed wall) any CMU that contains a surface chip exceeding 1/4" in any dimension. Painted CMU is a dominate finish material of the building interior and is a very important part of the finished product of the building. As such, scrutiny shall be exercised over the quality of the material.
- C. The sample wall panel shall be used as a quality reference. Any material not found to match quality of that found in sample panel will be rejected by the project manager.

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2.03 CONCRETE MASONRY UNITS (CMUS)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners, unless otherwise indicated.

B. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength for exposed units and where indicated.

C. Products

1. Addiment Incorporated; Block Plus W-10 - **Or Equal**
2. Grace Construction Products, a unit of W.R. Grace & Co. -Conn.; Dry Block. **Or Equal**
3. Master Builders, Inc.; Rheopel - **Or Equal**
4. Products are not limited to any listed above. "Equal" products will be considered. Manufacturers wishing to have products considered, please submit product literature to architect ten days prior to bid.

D. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Weight Classification: Lightweight
3. Pattern and Texture for Decorative Units: Standard pattern and ground finish.
4. Exposed Faces: See *Defective Units/Quality* text above

2.04 MASONRY LINTELS

A. General: Provide either masonry lintels, where specified, complying with requirements below.

B. Masonry Lintels: Built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing (refer to the lintel schedule shown on the structural drawings).

2.05 MORTAR AND GROUT MATERIALS

A. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C 150, Type I and II except Type III may be used for cold-weather construction.

2. Products:

- a. Capital Materials Corporation; Flamingo Color Masonry Cement.
- b. Essroc, Italcementi Group; Brixment or Velvet.
- c. Holcim (US) Inc.; Mortamix Masonry Cement.
- d. Lafarge North America Inc.; Lafarge Masonry Cement
- e. Lehigh Cement Company; Lehigh Masonry Cement
- f. National Cement Company, Inc.; Coosa Masonry Cement.

B. Colored Cement Product: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

- 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
- 2. Pigments shall not exceed 5 percent of masonry cement by weight.

3. Products

a. Colored Masonry Cement:

- (1) Capital Materials Corporation; Flamingo Color Masonry Cement.
- (2) Essroc, Italcementi Group; Brixment-in-Color.
- (3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
- (4) Lafarge North America Inc.; Magnolia Masonry Cement
- (5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
- (6) National Cement Company, Inc.; Coosa Masonry Cement.

C. Aggregate for Mortar: ASTM C 144.

- 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone..
- 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
- 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

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4. For joints less than $\frac{1}{4}$ inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

D. Hydrated Lime: ASTM C 207, Type S

E. Aggregate for Grout: ASTM C 404.

F. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products

- a. Addiment Incorporated; Mortar Kick.
- b. Euclid Chemical Company (The); Accelguard 80.
- c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
- d. Sonneborn, Div. of ChemRex; Trimix-NCA.

G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

H. Products

1. Addiment Incorporated; Mortar Tite. Or equal
2. Grace Construction Products, A unit of W.R. Grace & Co. – Conn.; Dry-Block. Or Equal
3. Master Builders, Inc.;
4. Products are not limited to any listed above. "Equal" products will be considered. Manufacturers wishing to have products considered, please submit product literature to architect ten days prior to bid.

I. Water: Potable.

2.06 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: Grade 60, Refer to the structural drawings.

B. Masonry Joint Reinforcement, General: ASTM A 951. Mill Galvanized, carbon-steel wire for interior walls and hot-dipped galvanized, carbon-steel wire for exterior walls.

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.

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2. Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch diameter, hot dip galvanized, carbon steel continuous wire.
 3. Interior Walls: mill galvanized, carbon steel.
 4. Exterior Walls: Hot-dip galvanized, carbon steel.
 5. Wire Size for Side Rods: W2.8 or 0.188-inch diameter..
 6. Wire Size for Cross Rods: W2.8 or 0.188-inch diameter.
 7. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter.
 8. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 9. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 2 side rods at each Wythe of masonry 4 inches or less in width.

2.07 METAL Z-FURRING STRIPS

- A. Metal Z-Furring Strips: Provide 2" continuous metal strip Z-Furring, 16 gauge hot dipped galvanized steel conforming to ASTM A653.

2.08 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 7 Section "Sheet Metal Flashing and Trim".
1. Metal Drip Edges: Fabricate From stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 2. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3.4 inch and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
- B. Flexible Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:

1. Copper-Laminated Flashing: [7 oz./sq.ft.] copper sheet bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

- a. Products

- (1) Advanced Building Products Inc.; Copper Fabric Flashing.
 - (2) AFCO Products Inc.; Copper Fabric.
 - (3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
 - (4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
 - (5) Polytite Manufacturing Corp.; Copper Fabric Flashing.
 - (6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
 - (7) York Manufacturing, Inc.; York Copper Fabric Flashing.
 - (8) Products are not limited to any listed above. "Equal" products will be considered. Manufacturers wishing to have products considered, please submit product literature to architect ten days prior to bid.

- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.09 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

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1. Products

- a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
- b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
- c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
- d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 SPRAY POLYURETHANE FOAM INSULATION

- A. See Division 7 – Thermal Insulation for specification of Spray Polyurethane Foam Insulation.

2.11 MASONRY CLEANERS

- A. Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers:

- a. Diedrich Technologies, Inc.
- b. EaCo Chem, Inc.
- c. ProSoCo, Inc.
- d. Products are not limited to any listed above. "Equal" products will be considered. Manufacturers wishing to have products considered, please submit product literature to architect ten days prior to bid.

2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

- 1. Do not use calcium chloride in mortar or grout.
- 2. Limit cementitious materials in mortar to Portland cement, and lime.
- 3. Limit cementitious materials in mortar for exterior and reinforced masonry to Portland cement, and lime.
- 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with BIA Technical Notes 8A, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, see reinforced unit masonry specification.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- D. Pigmented Mortar: Architect shall have the choice of selecting pigmented mortar for all or a portion of the brick work. Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement by weight.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or course) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
 - 3. Grout compressive strength, f'_c shall be 3,000 psi minimum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.

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- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8" in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.03 LAYING MASONRY WALLS

- A. Head joints shall align between courses and shall not be out of plumb from successive course by more than 1/8".
- B. Bed courses of new masonry shall align and course with bed course of existing masonry.
- C. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- D. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- E. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- F. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- G. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

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- H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- I. Build non-load-bearing interior partitions to heights indicated on drawings.
 - 1. For masonry specified continuous to deck, install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
- J. Fill Space Between steel frames and masonry solidly with mortar, unless otherwise indicated.
- K. Fill Cores in Hollow concrete masonry units with grout as indicated on drawings.

3.04 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.05 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

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1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- D. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- E. Provide continuity at wall intersections by using prefabricated T-shaped units.
- F. Provide continuity at corners by using prefabricated L-shaped units.
- G. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.06 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.07 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove any forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and the other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

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- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 48 inches.

3.08 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.
 - 2. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
- C. Form expansion joints in clay brick as follows:
 - 1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

3.09 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels as directed by the lintel schedule on the structural drawings.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 FIELD QUALITY CONTROL

- A. Special Inspectors: The OWNER will engage a qualified independent inspector to perform special- inspections as required by the Kentucky Building Code. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Refer to plans for an outline of the required special inspections of the masonry work.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: The OWNER will engage a qualified independent material testing agency to perform field tests and prepare test reports:

1. Payment for these services will be made by the OWNER.
 2. Retesting of materials failing to comply with specified requirements shall be done at CONTRACTOR's expense.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- G. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

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6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are CONTRACTOR's property. At completion of unit masonry work, remove from Project site.
- B. Remove excess waste, and legally dispose of off OWNER's property.

END OF SECTION

SECTION 05520
METAL FABRICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, and equipment required to construct and install metal fabrications as shown on the Drawings and specified herein. Included in this section are handrails, grating, nuts, bolts, anchors, hatches, ladders, and stairs.

1.02 RELATED WORK NOT INCLUDED

- A. Concrete work is included in Division 3.
- B. Castings are included in Division 5, Section 05540.
- C. Flashing and sheet metal work for roofing is included in Division 7, Section 07600.
- D. Painting is included in Division 9, Section 09900.

1.03 QUALITY ASSURANCE

- A. All fabricated materials shall be of the highest quality, free of structural, handling, and workmanship defects.
- B. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.04 SUBMITTALS

- A. Shop Drawings
 - 1. The CONTRACTOR shall submit to the ENGINEER in accordance with Division 1, Section 00700 (00710) detailed shop drawings of all materials to be fabricated, and shall receive the ENGINEER's certification of review before fabrication. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor bolt installation by others. Include any requirements for surface preparation, paint products, or grout.
 - 2. Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computations, material properties and other information needed for structural analysis. This shall not relieve the CONTRACTOR of responsibility for all errors, omissions, and deviations of his shop drawings from the Drawings and Specifications and from requirements of final results called for in the Drawings and Specifications.

B. Samples

1. The CONTRACTOR shall submit 2 sets of representative samples of materials and finished products as may be requested by the ENGINEER, or as specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel

1. Steel fabrication shall be done in conformity with the "AISC Load and Resistance Factor Design Specification for Structural Steel Buildings," Second Edition dated December 1, 1993, latest revision.
2. Prime and paint in accordance with Division 9, unless otherwise required or permitted.
3. Unless otherwise noted on the Drawings or in the Specifications, galvanizing shall be by hotdip process in accordance with ASTM A 525-93, Coating Designation G90 (previous Coating Class Commercial 1.25 oz per sq ft).
4. Damaged zinc coating shall be repaired according to Federal Specification DOD-21035A (Galvanizing Repair Spec.) and ASTM A 780-93a as follows:
 - a. Remove foreign matter from both damaged and contiguous undamaged area by wire brushing and cleaning with metal conditioner recommended by cold galvanizing coating manufacturer.
 - b. Apply 2 coats of cold galvanizing coating to damaged area, ensuring an overlap of the surrounding undamaged galvanizing for continuity of galvanic protection. Cold galvanizing coating shall be Z.R.C. Chemical Products Co., "Z.R.C. Cold Galvanizing" or Galvicon Corp., "Cold Galvanizing," or equal.

B. Aluminum

1. Aluminum shall have a high resistance to corrosion and shall be Alloys 6061-T6, 6062-T6, 6063-T5, 6063-T6, or 6105-T5 for wrought products such as rods, bars, standard structural shapes, extrusions, and forgings; and Alloy 214 for castings, or equal.
2. Aluminum fabrication shall be in accordance with ASCE the Aluminum Association "Specifications for Aluminum Structures," latest revision. Welding shall be done by the argon-shielded tungsten-arc method or the automatic or semi-automatic argon-shielded consumable-electrode method, or equal. Welding rods and electrodes shall be in strict accordance with above specifications.

3. Where anodic coating is required and type is not specified or shown on the Drawings, coating shall be Class II Clear (204-R1). Anodic coatings shall conform to the following requirements:
 - a. Clear Anodic Coatings
 - (1) Class II Clear (204-R1) (0.4 Mil Coating)
 - (a) The exposed surfaces of aluminum shall be cleaned of all fabricating oils and foreign matter, given a medium caustic etch pretreatment.
 - (2) Class I Clear (215-R1) (0.7 Mil Coating)
 - b. Color Anodic Coatings
 - (1) All aluminum parts (both extrusion and sheet stock) shall be of a controlled aluminum alloy and temper suitable for receiving an electrochemically produced hard anodic oxide coating. All aluminum parts (both extrusion and sheet stock) shall receive a caustic etch pretreatment to remove all surface foreign matter followed by an electrochemically produced anodic oxide coating having a minimum coating thickness of 0.7 mil. Color shall be specified by the OWNER and range samples shall be submitted to establish the upper and lower limits of color variations.

2.02 HANDRAILS AND TOEBOARDS

A. General

1. All handrail components and systems shall meet the requirements of Kentucky OSHA Standards for General Industry, ADAAG, and the Kentucky Building Code.
2. Handrail shall be the product of a company normally engaged in the manufacture of pipe railing.
3. Toeboards shall be provided on handrails as required by OSHA and as shown on the Drawings. (Examples of required locations are walkways, platforms, runways, and wherever tools, machine parts or materials are likely to be stored or fall to the next lower level.)
4. Openings in the railing shall be guarded by a self-closing handrail gate.
5. Handrail and toeboard finish shall be Aluminum Association M10-C22-A41 (215-R1). The pipe shall be plastic wrapped. The plastic wrap is to be removed after erection.

6. Aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bituminous paint or zinc chromate paint, mylar isolators, or other approved material.
7. The ENGINEER may request a vertical post sample. The sample shall include top and intermediate rail connections and base flange connection.
8. Shop drawing submittals shall include verification that all components, including base flanges, side mounting assemblies and anchor bolts, will meet required strength capacities. Anchorages shall be identical to those shown on the Drawings.
9. Acceptable manufacturers:
 - a. Thompson Fabricating Company - Tuf Rail
 - b. Hollaender Manufacturing Company - Interna-Rail
 - c. A manufacturer providing an acceptable equivalent product.

B. Standard Aluminum Handrail

1. Handrail posts spacing shall be a maximum of 6 feet 0 inches. Posts and railings shall be 1-1/2 inch diameter Schedule 40 aluminum pipe alloy 6061-T6, 6063-T6, or 6105-T5. The manufacturer shall show that their posts are of adequate strength to meet the loading requirements. If the manufacturer's posts are not of adequate strength, the manufacturer may reduce the post spacing or add reinforcing dowels or may do both in order to meet loading requirements.
2. Handrails and stair rails shall be designed to withstand a 200 lb concentrated load applied in any direction at any point on the top rail. Handrails and stair rails shall also be designed to withstand a load of 50 lb/ft applied horizontally to the top rail. The 200 lb load will not be applied simultaneously with the 50 lb/ft load. In addition, the handrails shall be designed to withstand a load of 100 lb/ft applied vertically downward to the top rail and simultaneously with the 50 lb/ft horizontal load. The 100 lb/ft vertical load does not apply to stair rails.
3. The manufacturer shall submit calculations to the ENGINEER for review. Testing of base castings or base extrusions by an independent laboratory or manufacturer's laboratory (if manufacturer's laboratory meets the requirements of the Aluminum Association) will be an acceptable substitute for calculations. Calculations will be required for approval of all other design aspects.
4. The handrail shall be made of pipes joined together with component fittings. All components must be mechanically fastened with stainless steel hardware. Components that are pop-riveted or glued at the joints will not be acceptable.

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5. 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.
6. Standard fasteners into concrete shall be 1/2-inch x 6-3/8 inch minimum embedment, AISI 304 stainless steel adhesive anchors. Anchor bolts shall be furnished by the handrail manufacturer.
7. Toeboard shall conform to OSHA standards. Toeboard shall be 4 inches high and shall be an extrusion that attaches to the posts with clamps which will allow for expansion and contraction between posts. Toeboard shall be set 1/4-inch above the walking surface.

2.03 GRATINGS

- A. Gratings shall be the dimensions required on the Drawings and as required to meet deflection specs. below and of aluminum Alloy 6063-T5, 6063-T6, or 6061-T6, or equal. Gratings shall be designed for an allowable uniformly distributed load of 200 lbs/sq ft and a concentrated load of 400 lbs/ft of width with less than 0.25-inch deflection.
- B. Gratings shall be IKG Industries "IBar," Reliance "ILok," or equal.

2.04 NUTS AND BOLTS

- A. Unless otherwise shown on the Drawings or required in other parts of these Specifications, all nuts and bolts shall be in accordance with ASTM A 307-93a, Grade A and shall be electrogalvanized according to ASTM B 633-85 (1994).
- B. All nuts, bolts, washers and accessories in contact with water, in any moist atmosphere or damp area such as occurs above water, or embedded in concrete exposed to the weather, shall be Type 302 or 304 stainless steel. Stainless steel nuts, bolts, and washers shall be used to fasten aluminum to all materials including aluminum.

2.05 CONCRETE ANCHORS

- A. Sizes and spacings or numbers of anchors shall be shown on the Drawings and materials shall comply with exposure requirements listed under Nuts and Bolts above. All anchors used for securing moving or vibrating equipment (pumps, motors, gears, sluice gates, conveyors, etc.), shall be of the cast-in-place type.
- B. The size and number of anchors shall be approved by the equipment manufacturer.
- C. Unless specifically noted otherwise on the Drawings or Specifications, concrete anchors for other applications shall be chemical grout-type anchors equal to

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Hilti "HVA Adhesive Anchor," or Ramset "Chemset Chemical Anchors." Installation shall be in strict accordance with the manufacturer's recommendations which shall be available on the job site.

2.06 GUARD POST

- A. Concrete filled, steel posts shall be as shown on Drawings.

PART 3 EXECUTION

3.01 GENERAL

- A. The CONTRACTOR shall be responsible for all errors, omissions, and deviations of the shop drawings from the Drawings and Specifications. Any errors or omissions shall be brought to the attention of the ENGINEER whose interpretation and instructions shall be received before proceeding with the fabrication of that portion of the work.
- B. Manufacturers' printed installation instructions shall be strictly followed and any conflicts with the shop drawings and/or Contract Drawings shall be directed to the ENGINEER for resolution before proceeding with installation.
- C. All base plates, inserts and anchorages shown embedded in concrete shall be accurately located and secured before placing concrete as per a manufacturer supplied template. All structural members and components shall be accurately leveled, plumbed and secured at locations shown on the Drawings.
- D. Painting
 - 1. Cleaning and painting of all fabricated materials shall be in strict accordance with Division 9, Section 09900, of these Specifications.
- E. Steel
 - 1. All fabrication and erection shall be done in conformity with the "AISC Load and Resistance Factor Design Specification for Structural Steel Buildings," Second Edition dated December 1, 1993, latest revision.
 - 2. Refer to Article 2.01.A of this Specification Section for repair of galvanized surfaces.
- F. Aluminum
 - 1. The contact surfaces of aluminum with steel, dissimilar materials, concrete and/or masonry shall be protected from corrosion by a coating of coal tar, Kop-Coat Bitumastic Super Service Black, or equal.
 - 2. Aluminum surfaces embedded in concrete shall be protected from corrosion by a tightly adherent coating of 2 applications of zinc chromate primer.

3.02 HANDRAILS

A. General

1. Shop drawings and handrail manufacturer's printed instructions shall be closely followed during handrail installation. Posts shall be installed plumb and rails parallel.
2. Required anchorages shall be strictly followed.

B. Workmanship

1. All rail and post cuts shall be square and accurate for minimum joint gap, clean and straight, and free of burrs and nicks.
2. In exterior and high humidity interior fabricated fitting installations, provision shall be made to drain entrapped water from inside the railing system to prevent electrolysis and/or damage from freezing. Manufacturer's printed instructions shall be strictly followed.
3. Welds and damaged areas shall be finished and coated according to Article 2.02, this Section.
4. Where required, holes shall be drilled and countersunk the correct size for proper fit of all components.
5. In aluminum handrail systems where protection is applied for prevention of electrolysis from dissimilar materials, visibility of protective material shall be minimized.
6. Handrail system surfaces shall be protected from physical damage and discoloration during storage, assembly and installation. Manufacturer's coverings to protect anodized finishes shall be left intact until damage from construction operations no longer exists.

C. Rigidity

1. Posts shall be continuous from mounting surface to top rail.
2. Top and bottom rails shall be unspliced lengths between posts except as covered under expansion joints.
3. Railing manufacturer's instructions shall be strictly followed regarding torquing and tightening of fittings, and type and materials of fasteners.
4. Only stainless steel fasteners shall be used in aluminum installations, unless otherwise noted.

D. Expansion Joints

1. To prevent excessive stresses and misalignment in standard aluminum handrail systems, expansion joints and gaps shall be provided in top and bottom rails. Joints shall be located within 8 inches of posts and supports and the top and bottom rail joints shall be in vertical alignment. In fence-type handrail systems, top rail couplings shall be furnished with galvanized expansion compression spring as required in PART 2, this Section.
2. Where sleeve-type expansion joints are used, fasten only one side of sleeve to rail and allow other side of sleeve to slide on adjacent rail in standard aluminum handrail systems.
3. Gaps shall be provided according to the table below which is based on coefficients of expansion of 0.000013 inch/°F for aluminum and 0.0000065 inch/°F for steel; a temperature difference of 120 degrees Fahrenheit less the minimum listed temperature; and an expansion joints spacing of 24 feet 0 inches on centers for aluminum and 40 feet 0 inches on centers for steel. Where it is known that other temperature differentials and/or expansion joint spacings will be experienced, gap dimensions can be determined by: gap in inches = (coefficient of expansion) x (temperature difference from maximum to minimum) x (distance in inches between expansion joints).

EXPANSION JOINTS GAP TABLE

<u>Temperature (°F) at Time of Installation</u>	<u>Gap Dimension Required at Each Expansion Joint</u>	
	<u>Aluminum Railing with Expansion Joints on 24'-0" Centers</u>	<u>Steel Railing with Expansion Joints on 40'-0" Centers</u>
-20 to 0	1/2"	7/16"
0 to 20	7/16"	3/8"
20 to 35	3/8"	5/16"
35 to 50	5/16"	1/4"
50 to 70	1/4"	1/4"
70 to 90	3/16"	3/16"
90 to 120	1/8"	1/8"

3.03 GRATINGS

- A. Grating frames shall be installed flush with the floor surface. Adequate blocking shall be provided to hold corners square during placing concrete and exposed aluminum surfaces shall be protected to prevent pitting from the concrete. Surfaces embedded in concrete shall be protected as covered under Article 3.01, this Section.

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3.04 NUTS AND BOLTS

- A. Bolts embedded in concrete shall be secured with templates at the time of pouring concrete. Bolts shall be suitably protected from damage throughout the construction period.
- B. Damaged galvanized surfaces on nuts and bolts shall be repaired according to Article 2.04, this Section.

3.05 CONCRETE ANCHORS

- A. Concrete anchors shall be installed strictly in accordance with manufacturer's printed instructions which shall be available on the job site.
- B. Refer to Division 15 for supporting small pipe.

3.06 LADDERS

- A. Install ladders as herein specified and as detailed on the Drawings.

3.07 HATCHES

- A. Install hatches as herein specified and as detailed on the Drawings.

3.08 GUARD POSTS

- A. Set in concrete as indicated. Fill cores solidly with air-entrained concrete having a 28-day minimum compressive strength at 3,000 psi.

END OF SECTION

SECTION 05540

CASTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, and equipment required to install castings as shown on the Drawings and specified herein. Included in this section are manhole covers, steps, valve boxes, and hatch covers.

1.02 RELATED WORK NOT INCLUDED

- A. Concrete work is included in Division 3.
- B. Masonry work is included in Division 4.
- C. Surface preparation and finishing of castings is included in Division 9, Section 09900.
- D. Floor drains and roof drains are included in Division 15, Section 15400.
- E. Special cast valves are included in Division 15, Section 15101.

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit to the ENGINEER, in accordance with Division 1, Section 00700 (00710), copies of construction details of castings proposed for use.

PART 2 MATERIALS

2.01 GENERAL

- A. All castings shall be gray iron, conforming to the requirements of the ASTM Standards, Designation A 48-83, Class 35-B for manhole casting and class 20 for valve boxes.

2.02 VALVE BOXES

- A. Slide Type for Iron Body Gate Valves
 - 1. Valve boxes for sizes through 12-inch valves shall be the cast iron slide type, without screw, of sufficient length to allow for 30 inches of cover over the top of the pipe. The inner section shall have a minimum inside diameter of 5-1/4 inches with a hood type base that will cover the packing gland on valves through 12 inches in size (minimum of 8 inches inside diameter). The base of the top section shall be flanged at least 1-1/4 inches. The caps shall be circular with a corrugated surface and have pick holes in the periphery and be marked "Water," "Gas," "Sewer," or

"Air" according to use. The valve boxes shall be Tyler Pipe/Utilities Division, 6855 Series, or equal.

2. For vertical valves larger than 12-inch size, provide Tyler Pipe/Utilities Division Series 6865 with No. 8 base, or equal.
3. Valve boxes for valves in the horizontal position shall be cast iron Tyler Pipe/Series 6855 or equal, with a base that is sized to allow covering of the bevel gear case and centering of the operating nut in the valve box.

PART 3 EXECUTION

3.01 INSTALLATION OF CASTINGS

A. Installation In or On Structures

1. The installation of castings is generally covered under specifications for pipe work and manholes. Castings shall be leveled, plumbed and secured before pouring concrete or attaching to masonry with solid, watertight, cement mortar joints.

B. Installation on Buried Valves

1. Valve box construction shall consist of the approved manufactured box and accessories. Line pipe shall not be accepted for use as valve boxes.
2. Mechanically tamp backfill, or backfill with crushed rock (per requirements of location - see Section 02610 of these Specifications) to the bottom of the packing gland of the operating nut. Install valve box base centered over operating nut.
3. Install valve box shafts, of the required height, and top section to proposed top elevation. Mechanically tamp backfill around box or backfill with crushed rock.
4. Place reinforced concrete collar around top section when shown on the Drawings.
5. Furnishing and installation of the valve box and accessories, including the concrete valve box collar, shall be included in the price bid for furnishing and installation of the valve.

END OF SECTION

SECTION 06105

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:

- 1. Nailers
- 2. Blocking

1.03 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. NLGA: National Lumber Grades Authority.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPAA: Western Wood Products Association.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPAC2

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a **maximum moisture content of 19 percent**. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood, blocking, and similar concealed members in contact with masonry or concrete.

2.03 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. For items of dimension lumber size, provide **Construction or No. 2 grade lumber with 19 percent maximum moisture content** of species listed.

1. Hem-fir (north); NLGA.

2. Mixed southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 5. Northern species; NLGA.
 6. Eastern softwoods; NeLMA.
- C. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, **provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.**
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.05 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. Harlen Metal Products, Inc.
 - 3. KC Metals Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. Southeastern Metals Manufacturing Co., Inc.
 - 6. USP Structural Connectors.

Products and manufacturers are not limited to any listed above. "Equal" products will be considered. Manufacturers wishing to have products considered, please submit product literature to architect ten days prior to bid.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.

- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

- 1. NES NER-272 for power-driven fasteners.
- 2. 2002 Kentucky Building Code

3.02 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 WOOD FURRING INSTALLATION

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

3.04 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06161

SHEATHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Roof sheathing.
 - 2. Sheathing joint-and-penetration treatment.
 - 3. Flexible flashing at openings in sheathing.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for plywood backing panels.

1.03 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. For building wrap, include data on air/moisture-infiltration protection based on testing according to referenced standards.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.01 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.02 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior, Structural I sheathing. CDX Plywood
 - 1. Span Rating: Not less than 16/0, see plans.
 - 2. Nominal Thickness: Not less than 5/8", see plans.

2.03 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, **with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.**
 - 1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

2.04 WEATHER-RESISTANT SHEATHING PAPER

- A. Building Paper: ASTM D 226, Type 1 (**No. 15 asphalt-saturated organic felt**), unperforated.
- B. Building Wrap: ASTM E 1677, Type I air retarder; with **flame-spread and smoke-developed indexes of less than 25 and 450**, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
 - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
 - c. Pactiv, Inc.; GreenGuard Ultra Wrap.
 - 2. Water-Vapor Permeance: Not less than 535 g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
 - 3. Allowable UV Exposure Time: Not less than three months.
- C. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.05 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor V40 Weather Barrier Strips.
 - c. MFM Building Products Corp.; Window Wrap.
 - d. Polyguard Products, Inc.; Polyguard 300.
 - e. Protecto Wrap Company; PS-45.

- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
 - 4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
 - 5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
 - 6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
 - 7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.

3.03 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

- A. General: Cover sheathing with weather-resistant sheathing paper as follows:
 - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.
- B. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.
- C. Building Wrap: Comply with manufacturer's written instructions.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.04 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

3.05 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturers written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.

2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
4. Lap weather-resistant building paper over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION

SECTION 07200

INSULATION AND AIR/WATER VAPOR BARRIERS

PART 1 GENERAL

1.01 SUMMARY

- A. Work in this section includes, but is not limited to:
 - 1. Wall, roof and floor insulation.
 - 2. Air barriers.
 - 3. Water vapor retarders/barriers.
- B. This specification section is a general specification indicating that all heated and/or air conditioned spaces are to be separated from non-heated and/or air conditioned spaces by insulation and/or air and vapor barriers. It further notes what insulation values are to be used for walls, ceilings/roofs and floors if the drawings and other specifications do not indicate a value. It also notes what building and energy codes are applicable if further information is desired and it notes some other general or minimal information.

1.02 SUBMITTALS

- A. As listed in the appropriate spec section for each material.

1.03 QUALITY ASSURANCE

- A. As listed in the appropriate spec section for each material.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: As listed in the appropriate spec section for each material.
- B. Storage and Handling: As listed in the appropriate spec section for each material.

1.05 DEFINITIONS

- A. Thermal Resistivity: Where the thermal resistivity of insulation products is designated by "R-values," they represent the reciprocal of thermal conductivity (K-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.06 SYSTEM DESCRIPTION

- A. It is the intent of these Specifications to have new structures which include extensions to existing buildings and any structure which is heated and/or air conditioned meet the 2013 Kentucky Building Code Fourth Edition and by reference the 2012 International Building Code (IBC) and the 2012 International Energy Conservation Code (IECC) with regard to insulation and air and vapor barriers. As such, all external surfaces, i.e., walls, floors, and roofs are to be encased by insulation, air barriers, and/or vapor retarders/barriers. When insulation "R" values are noted, they are referring to the Long-Term Thermal Resistance (LTTR) value as defined by ASTM C518, at 75 degrees Fahrenheit, unless otherwise noted.
- B. The air barrier systems shall cover all external walls, ceilings, roofs, and floors. All openings including gaps between insulation panels, window/door frames and walls, etc., shall be caulked, weather-stripped or otherwise sealed to prevent air movement into the structure as required by the 2012 IBC and the 2012 IECC.
- C. Insulation, air and vapor barrier manufacturers or a factory trained installer or factory representative shall certify that their systems have been installed as recommended, and that they meet the requirements of the 2012 IBC and 2012 IECC.
- D. All internal rooms which are conditioned shall have their internal walls, floors, and ceilings insulated when adjacent to an unconditioned space. As a minimum, internal concrete block walls shall have their cores filled with foam insulation, Thermal Corporation of America (Thermco), or equal.
- E. As a minimum all walls shall have a minimum insulation R value of R10 between the veneer and the block wall, unless otherwise noted. All roofs shall have a minimum insulation R value of 25 continuous insulation when installed entirely above deck or R38 when installed in attic spaces, unless otherwise noted. Walls below grade shall have a minimum insulation R value of 10 of continuous insulation and floor shall have a minimum insulation R value of 10 of continuous insulation.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 07210
THERMAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter insulation under slabs-on-grade.
 - 2. Concealed building insulation.
- B. Related Sections include the following:
 - 1. Division 09 Sections "Gypsum Board" for installation in metal-framed assemblies of insulation specified by referencing this Section.

1.03 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
 - 1. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.
- C. Research/Evaluation Reports: For foam-plastic insulation.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively.
 - 1. Manufacturers:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company.
 - c. Owens Corning.

d. Pactiv Building Products Division.

2.03 GLASS-FIBER BLANKET INSULATION

A. Manufacturers:

1. CertainTeed Corporation.
2. Guardian Fiberglass, Inc.
3. Johns Manville.
4. Knauf Fiber Glass.
5. Owens Corning.

B. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on 1 face.

C. **Any and all batt insulation installed above ceiling (or not concealed in a wall cavity) shall be foil-scrim faced on each exposed face. Design Basis: Johns Manville FSK-25 Faced Batts with a fire hazard classification rating of 25/50 or less per ASTM E 84.**

D. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:

1. 6 inches thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F.

2.04 MINERAL WOOL INSULATION

A. General

1. Where fiberglass insulation is noted, comparable mineral wool insulation may be used.

B. Manufacturers

1. Johns Monville
2. Thermafiber (Owens Corning)
3. Roxal
4. or equal

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2.05 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.

2.06 INSULATION FASTENERS

- A. Provide any miscellaneous fasteners or adhesives as recommended by manufacturer to properly install insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.03 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.05 INSTALLATION OF CAVITY-WALL INSULATION

- A. See Division 4 Unit Masonry for specification of Cavity wall insulation.

3.06 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install board insulation on concrete substrates adhesive material:
 - 1. Fasten insulation to substrates as recommended by manufacturer.
- E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

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3.07 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07261

SELF-ADHERING AIR AND VAPOR BARRIER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section specifies a water-resistant self-adhering sheet air and vapor barrier in exterior wall assemblies.
- B. Related Work in other Sections include the following:
 - 1. Section 01400 – Quality Requirements; coordination with Owner's independent testing and inspection agency.
 - 2. Section 01500 – Temporary Facilities and Controls; requirement to schedule work to prevent sunlight and weather exposure of materials beyond limits established by manufacturer; requirement to protect materials from damage after installation and prior to installation of enclosing work.
 - 3. Section 03300 – Cast-In-Place Concrete; requirement that backup concrete be free of fins, protrusions and large holes.
 - 4. Section 04200 – Unit Masonry; requirement that backup masonry joints are flush and completely filled with mortar, and that excess mortar on brick ties will be removed; requirement for gap at deflection joints and fillers; coordination with sequencing of through-wall flashing.

1.02 PERFORMANCE REQUIREMENTS

- A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 pounds per square foot) when tested according to ASTM E 2178, and a vapor permeance of 0.1 perms or less when tested according to ASTM E 96.
- B. Connections to Adjacent Materials: Provide connections to prevent air leakage and vapor migration at the following locations:
 - 1. Foundation and walls, including penetrations, ties and anchors.
 - 2. Walls, windows, curtain walls, storefronts, louvers or doors.
 - 3. Different wall assemblies, and fixed openings within those assemblies.
 - 4. Wall and roof connections.
 - 5. Floors over unconditioned space.
 - 6. Walls, floor and roof across construction, control and expansion joints.

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7. Walls, floors and roof to utility, pipe and duct penetrations.
8. Seismic and expansion joints.
9. All other leakage pathways in the building envelope.

1.03 SUBMITTALS

- A. Submittals: Submit in accordance with Section 00700/00710 requirements.
- B. Quality Assurance Program: Submit evidence of current accreditation and certification under the Air Barrier Association of America's (ABAA) Quality Assurance Program. Submit accreditation number of contractor and certification number of installers.
- C. Product Data: Submit manufacturer's product data, manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
 1. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
 2. Include statement that materials are compatible with adjacent materials proposed for use.
 3. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.
- D. Samples: Submit clearly labeled samples, 3 by 4 inch (75 mm by 100 mm) minimum size of each material specified.
- E. Shop Drawings of Mock-Up: Submit shop drawings of proposed mock-ups showing plans, elevations, large-scale details, and connections to the test apparatus.
- F. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.
- G. Shop Drawings: Submit shop drawings showing locations and extent of air and vapor barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the air and vapor barrier are secured with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.

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1. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.
 2. Include statement that materials are compatible with adjacent materials proposed for use.
 3. Include recommended values for field adhesion test on each substrate.
- H. Compatibility: Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

1.04 QUALITY ASSURANCE

- A. Air Barrier Contractor Qualifications: Currently accredited by the Air Barrier Association of America (ABAA) whose applicators are certified in accordance with the ABAA Quality Assurance Program.
- B. Manufacturer: Obtain primary materials from a single manufacturer regularly engaged in manufacturing air and vapor barrier membranes. Obtain secondary materials from a source acceptable to the primary materials manufacturer.
- C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).
- D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.
- E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction and testing of mock-up, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials and adjacent materials.
- F. Field Quality Assurance: Implement the ABAA Quality Assurance Program requirements. Cooperate with ABAA inspectors and independent testing and inspection agencies engaged by the Owner. Do not cover air and vapor barrier membrane until it has been inspected, tested and accepted.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

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- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air and vapor barrier membrane manufacturer. Protect stored materials from direct sunlight.
- C. Handle materials in accordance with manufacturer's recommendations.

1.06 PROJECT CONDITIONS

- A. Temperature: Install air and vapor barrier within range of ambient and substrate temperatures recommended by air and vapor barrier manufacturer. Do not apply air and vapor barrier to a damp or wet substrate.
- B. Field Conditions: Do not install air and vapor barrier in snow, rain, fog, or mist. Do not install air and vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

1.07 WARRANTY

- A. Material Warranty: Provide manufacturer's standard product warranty, for a minimum 3 years from date of Substantial Completion.
- B. Installation Warranty: Provide installer's 2 year warranty from date of Substantial Completion, including all components of the air and vapor barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sheet Air and Vapor Barrier: Self-adhering membrane composed of flexible facing material coated completely and uniformly on one side with adhesive material, formed into uniform, flexible sheets, interleaved with disposable release liner that is removed prior to application. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer. Subject to compliance with requirements, provide one of the following:
 - 1. Carlisle Coatings and Waterproofing:
 - a. Air and Vapor Barrier Membrane: CCW-705, 40 mils thick.
 - b. Water-Based Primer: CCW-AWP Water-Based Primer.
 - c. Solvent-Based Primer: CCW-702 Solvent-Based Primer.
 - d. Solvent-Based Aerosol Primer: CAV-GRIP.
 - e. Counterflashing for Masonry Through-Wall Flashings: CCW-705 TWF.
 - f. Mastics, Adhesives and Tapes: CCW-704 Solvent-Based Rubberized Asphalt Mastic.

2. Grace Construction Products:
 - a. Air and Vapor Barrier Membrane: Perm-A-Barrier, 40 mils thick.
 - b. Water-Based Primer: Perm-A-Barrier WB Primer.
 - c. Solvent-Based Primer: Bituthene Primer B-2.
 - d. Counterflashing for Masonry Through-Wall Flashings: Perm-A-Barrier Flashing.
 - e. Mastics, Adhesives and Tapes: As recommended by manufacturer.
3. Henry:
 - a. Air and Vapor Barrier Membrane: Blueskin SA, 40 mils thick.
 - b. Water-Based Primer: Aquatac.
 - c. Solvent-Based Primer: Blueskin Primer.
 - d. Counterflashing for Masonry Through-Wall Flashings: Blueskin TWF.
 - e. Mastics, Adhesives and Tapes: Henry 570-05 Polybitume.
4. Protective Coatings Technology, Inc.:
 - a. Air and Vapor Barrier Membrane: Poly-Wall Crack Guard, 25 mils thick.
 - b. Water-Based Primer: As recommended by manufacturer.
 - c. Solvent-Based Primer: Poly-Wall AirLok or AirLok Flex as recommended.
 - d. Counterflashing for Masonry Through-Wall Flashings: Poly-Wall Crack Guard.
 - e. Mastics, Adhesives and Tapes: As recommended by manufacturer.
5. Tremco, Inc.
 - a. Air and Vapor Barrier Membrane: ExoAir 110, 40 mils thick.
 - b. Water-Based Primer: ExoAir WB Primer.
 - c. Solvent-Based Primer: ExoAir Primer or GM Primer or ExoAir 10 Primer as recommended.
 - d. Counterflashing for Masonry Through-Wall Flashings: ExoAir TWF.
 - e. Mastics, Adhesives and Tapes: As recommended by manufacturer.
6. W. R. Meadows, Inc.:
 - a. Air and Vapor Barrier Membrane: Air-Shield, 40 mils thick.
 - b. Water-Based Primer: Mel-Prime Water Base.
 - c. Solvent-Based Primer: Mel-Prime VOC.
 - d. Counterflashing for Masonry Through-Wall Flashings: Detail Strip.
 - e. Mastics, Adhesives and Tapes: As recommended by manufacturer.

2.02 AUXILIARY MATERIALS

- A. Sealant at Transitions in Substrate and Connections to Adjacent Elements: Low-modulus pre-cured silicone extrusion and sealant for bonding extrusions to substrates; Tremco Silicone Extruded Sheet by Tremco, Spectrem EZ Seal by Tremco, or Bondaflex Silbridge 300 by May National Associates.

- B. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air and vapor barrier manufacturer's recommendations and material manufacturer's recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions under which air and vapor barrier assemblies will be applied, with Installer present, for compliance with requirements.
 - 1. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 2. Do not proceed with installation until after minimum concrete curing period recommended by air and vapor barrier manufacturer.
 - 3. Ensure that the following conditions are met:
 - a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
 - b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
 - c. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
 - 4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
 - 5. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
 - 6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for air and vapor barrier application.
 - 1. Prime masonry, concrete substrates with conditioning primer.
 - 2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
 - 3. Prime wood, metal, and painted substrates with primer.

4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air and vapor barrier and at protrusions.

3.03 INSTALLATION

- A. Self-Adhering Sheet Air and Vapor Barrier: Install membrane to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and the following:
 1. Apply primer at rate recommended by manufacturer prior to membrane installation. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.
 2. When membrane is properly positioned, press into place and roll membrane with roller immediately after placement.
 3. Apply membrane sheets to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
 4. Position subsequent sheets of membrane applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll into place with roller.
 5. Overlap horizontally adjacent pieces a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll seams with roller.
 6. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counterflashing or other procedure in accordance with manufacturer's recommendations.
 7. Connect air and vapor barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors and other intersection conditions and perform sealing of penetrations, using accessory materials and in accordance with the manufacturer's recommendations.
 8. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
 9. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate.
 10. At through-wall flashings, provide an additional 6 inch wide strip of manufacturer's recommended membrane counterflashing to seal top of

through-wall flashing to membrane. Seal exposed top edge of strip with bead of mastic as recommended by manufacturer.

11. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
12. At expansion and seismic joints provide transition to the joint assemblies.
13. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
14. At end of each working day, seal top edge of membrane to substrate with termination mastic.
15. Do not allow materials to come in contact with chemically incompatible materials.
16. Do not expose membrane to sunlight longer than as recommended by the manufacturer.
17. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

- A. Owner's Inspection and Testing: Cooperate with Owner's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
- B. Air Barrier Association of America Installer Audits: Cooperate with ABAA's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

3.05 PROTECTING AND CLEANING

- A. Protect air and vapor barrier assemblies from damage during application and remainder of construction period, according to manufacturer's written instructions.
 1. Coordinate with installation of materials which cover air and vapor membrane, to ensure exposure period does not exceed that recommended by the air and vapor barrier manufacturer.

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- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

END OF SECTION

SECTION 07262

LIQUID-APPLIED AIR/VAPOR BARRIER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes the following:

1. Materials and installation methods for a liquid-applied air/vapor barrier system located in the non-accessible part of the wall.
2. SRAB (sheet rubberized-asphalt barrier) self-adhered air/vapor barrier membrane in roof assemblies.
3. Roof membrane air barrier.
4. Materials and installation to bridge and seal the following air leakage pathways and gaps:
 - a. Connections of the walls to the roof air barrier.
 - b. Connections of the walls to the foundations.
 - c. Seismic and expansion joints.
 - d. Openings and penetrations of window frames, store front, curtain wall.
 - e. Barrier precast concrete and other envelope systems.
 - f. door frames.
 - g. Piping, conduit, duct and similar penetrations
 - h. Masonry ties, screws, bolts and similar penetrations.
 - i. All other air leakage pathways in the building envelope.

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- A. Sheet metal flashings to be built into masonry are furnished under Section 07620.

1.03 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete:

1. Concrete back-up walls
2. Underslab vapor retarder.

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- B. Section 04200 - Unit Masonry:
 - 1. Masonry backup walls
 - 2. Masonry veneer cavity walls.
- C. Section 07210 - Building Insulation: Insulation with integral vapor retarder facing.
- D. Section 07530 - Single-Ply Membrane Roofing
- E. Section 07620 - Sheet Metal Flashing and Trim: Sheet metal flashings.
- F. Section 07900 - Joint Sealers: Joint sealant materials and installation.
- G. Section 08220: FRP doors and door frames.
- H. Section 08330: Aluminum rolling service doors.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide air/vapor barrier constructed to perform as a continuous air/vapor barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.
- B. The intent of this Specification is to require compliance with Moisture Control and Air Leakage requirements.
 - 1. Moisture Control:
 - a. A vapor barrier (material) having a maximum permeability of zero point one (0.1) perm or less (equivalent to a 4 mil polyethylene sheet) shall be installed on the winter warm side of walls, ceilings and floors enclosing a conditioned space.
 - 2. Air Barriers: "The building envelope shall be constructed with a continuous air barrier to control air leakage into, or out of the conditioned space." "The air barrier shall have the following characteristics:
 - a. It must be continuous, with all joints made air-tight.
 - b. It (the material used) shall have an air permeability not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/s.m² @ 75 Pa.) when tested in accordance with ASTM E2178-01.
 - c. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without

damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.”
“The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:

- (1) Foundation and walls.
 - (2) Walls and windows or doors.
 - (3) Different wall systems.
 - (4) Wall and roof.
 - (5) Wall and roof over unconditioned space.
 - (6) Walls, floor and roof across construction, control and expansion joints.
 - (7) Walls, floors and roof to utility, pipe and duct penetrations.
3. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air-tight.

1.05 SUBMITTALS

A. Provide submittals in accordance with Section 00700/00710.

1. At bid submission, provide evidence to the Architect of licensing and certification under the Air Barrier Association of America’s (ABAA’s) Quality Assurance Program.
2. Submit shop drawings showing locations and extent of air/vapor barrier and details of all typical conditions, intersections with other envelope systems and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and the like are sealed.
3. Submit manufacturer's product data sheets for each type of membrane, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
4. Submit manufacturer’s data showing solids content of fluid applied membranes and coverage rates and wet film thickness upon application in order to achieve minimum dry film thickness required by this specification.
5. Submit manufacturer's installation instructions,.

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6. Submit air/vapor barrier manufacturer's documentation of volatile organic compounds (VOC) content.
7. Certification of compatibility by air/vapor barrier manufacturer, listing all materials on the project that the air/vapor barrier may connect to or may come in contact with as indicated by the manufacturer.
8. Submit samples, 3 by 4 inch (75 by 100 mm) minimum size, of each air/vapor barrier material required for Project
9. Test results of air permeability testing of primary air barrier material (ASTM E 2178-01)
10. Test results of assembly in accordance with ABAA test protocol.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, officially recognized as a Licensed Contractor by the Air Barrier Association of America (ABAA). The contractor shall carry liability insurance and bonding.
2. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA
3. Each Lead Certified Applicator can supervise a maximum of five registered installers. The Certified Applicator shall be thoroughly trained and experienced in the installation of air barriers of the types being applied. Lead Certified Applicators shall perform or directly supervise all air/vapor barrier work on the project.

- B. Air/vapor barrier installers must be trained and certified by NECA (National Energy Conservation Association) and PSDI (Professional Skills Development Institute for energy conservation)
- C. Single-Source Responsibility: Obtain air/vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.
- D. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).
- E. Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed air and vapor barrier membrane unless it has been inspected, tested and approved.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

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- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Protect stored materials from direct sunlight.
- C. Avoid spillage. Immediately notify Owner, Consultant if spillage occurs and start clean up procedures.
- D. Clean spills and leave area as it was prior to spill.

1.08 WASTE MANAGEMENT AND DISPOSAL

- A. Place materials defined as hazardous or toxic waste in designated containers.
- B. Ensure emptied containers are sealed and stored safely for disposal away from children.

1.09 PROJECT CONDITIONS

- A. Environmental Conditions: Apply air/vapor barrier within range of ambient and substrate temperatures recommended by air/vapor barrier manufacturer. Do not apply air/vapor barrier to a damp or wet substrate, unless the manufacturer specifically permits that for the product.
 - 1. Do not apply air/vapor barrier in snow, rain, fog, or mist.
 - 2. Do not apply air/vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

1.10 WARRANTY

- A. For sealant and membrane materials the 12 months warranty period prescribed in 00700 - General Conditions is extended to 24 months.
- B. Material Warranty: Provide the manufacturer's 3 year air/vapor barrier material warranty under provisions of Section 00700 - General Conditions and 00800 - Supplementary Conditions.
- C. System Warranty: Provide the installer's 3 year system warranty, including the primary air/vapor barrier and installed accessory sealant and membrane materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MATERIALS & MANUFACTURERS

- A. Liquid Seal Type 1: Elastomeric modified bitumen, Synthetic rubber, roller, trowel, spray-applied, minimum total dry film thickness of 0.060 inch (1.5 mm) or greater based on manufacturer's recommendations.

1. Acceptable Materials

- a. Air-Blok 06; Spray or trowel applied elastomeric Air/Vapor Barrier Membrane as manufactured by Henry Company.
- b. Air-Bloc 21, Trowel-applied synthetic rubber Air/Vapor Barrier and Insulation Adhesive as manufactured by Henry Company Inc.
- c. Air-Bloc 21FR, Trowel-applied Fire Resistive Air/Vapor and Insulation Adhesive as manufactured by Henry Company Inc..
- d. Air-Bloc 21S Spray Applied Air/Vapor Barrier Insulation Adhesive as manufactured by Henry Company Inc.
- e. Air-Bloc 32, Spray or trowel applied low VOC elastomeric emulsion air/vapor barrier as manufactured by Henry Company Inc.
- f. Perm A Barrier Liquid® Air/Vapor Barrier fluid applied synthetic latex rubber membrane as manufactured by Grace Construction Products.
- g. Rub-R-Wall Airtight Air/Vapor Barrier, liquid applied rubber co-polymer membrane as manufactured by Rubber Polymer Corporation.
- h. Air-Shield™ LM as manufactured by W.R. Meadows, Inc.
- i. Barriseal Liquid-Applied Air/Vapor Barrier by Carlisle Coatings & Waterproofing.
- j. ExoAir™ 120 Fluid-Applied Air/Vapor Barrier by Tremco, Inc.
- k. Poly-Wall AirLok or AirLok Flex; Protective Coatings Technology, Inc.

2.02 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by air/vapor barrier manufacturer for intended use and compatible with the air/vapor barrier membrane.

- 1. SRAB flashing to counterflash metal flashings: SRAB Membrane Flashing: 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) cross-laminated, high density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane shall be interleaved with disposable silicone-coated release paper until installed:
 - a. Blueskin® TWF by Henry Company,
 - b. Perm-A-Barrier Wall Flashing by Grace Construction Products.
 - c. Air-Shield™ by W.R. Meadows, Inc.

- d. CCW-705 TWF by Carlisle Coatings & Waterproofing
- e. ExoAir™ TWF by Tremco, Inc.
- 2. SRAB flashing to counterflash metal flashings: SRAB Membrane Flashing: 0.9 mm (36 mils) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (4 mil) cross-laminated, high density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane shall be interleaved with disposable silicone-coated release paper until installed:
 - a. Poly-Wall Crack Guard; Protective Coatings Technology, Inc., or equal.
- 3. Butyl-based peel and stick membrane: Transition between air/vapor barrier membrane and TPO or EPDM membranes.
 - a. Grace Ultra by Grace Construction Products
- 4. Primer: Water based liquid primer for extruded polystyrene, concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;
 - a. Aquatac as manufactured by Henry Company Inc
 - b. Perm-A-Barrier® WB Primer by Grace Construction Products
 - c. Mel-Prime™ Water-Base Primer by W.R. Meadows, Inc.
 - d. CCW-AWP Water-Based Primer by Carlisle Coatings & Waterproofing
 - e. ExoAir™ WB Primer by Tremco, Inc.
- 5. Primer: Solvent based, VOC compliant primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;
 - a. Bituthene Primer B-2 by Grace Construction Products.
 - b. Blueskin® Primer by Henry Company Inc.
 - c. Mel-Prime™ Solvent-Base VOC Primer by W.R. Meadows, Inc.
 - d. CCW-702 Solvent-Based Primer by Carlisle Coatings & Waterproofing
 - e. ExoAir™ GM (Glass-Mat) Primer or ExoAir™ Primer by Tremco, Inc.
 - f. Poly-Wall AirLok or AirLok Flex; Protective Coatings Technology, Inc.
- 6. Mastic, Adhesives: Liquid mastic and adhesives as recommended by SRAB or liquid membrane air barrier material manufacturer.
- 7. Stainless-Steel Sheet Flashing: ASTM A167, Type 304, soft annealed, with No. 2D finish; minimum, 0.0156 inch (0.4 mm) thick.

8. Transition Strip: Smooth surfaced SBS modified bitumen membrane, nominal 1 mm (40 mil) thickness, width as required.
 - a. Blueskin® SA as manufactured by Henry Company Inc.
 - b. Vycor V-40 Weather Barrier Strips, by Grace Construction Products ,
 - c. Perm-A-Barrier Wall Membrane, by Grace Construction Products
 - d. Air-Shield™ by W.R. Meadows, Inc
 - e. CCW Window & Door Flashing or CCW-705 by Carlisle Coatings & Waterproofing
 - f. ExoAir™110 by Tremco, Inc.
 - g. Poly-Wall Crack Guard; Protective Coatings Technology, Inc.
9. Transition Strip Primer:
 - a. Blueskin® Primer as manufactured by Henry Company Inc.
 - b. Perm-A-Barrier® WB Primer by Grace Construction Products.
 - c. Mel-Prime™ Water-Based Primer or Mel-Prime™ Solvent-Base VOC Primer by W.R. Meadows, Inc
 - d. CCW-702 Solvent-Based Primer or CCW-AWP Water-Based Primer by Carlisle Coatings & Waterproofing
 - e. ExoAir™ WB Primer or ExoAir™ GM (Glass-Mat) Primer or ExoAir™ Primer by Tremco, Inc.
 - f. Poly-Wall AirLok or AirLok Flex; Protective Coatings Technology, Inc.
10. Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Non-reinforced, cured chloroprene polymer sheet (neoprene) complying with ASTM D2000 Designation 2BC415 to 3BC620, 50 to 65 mils (1.3 to 1.6 mm) thick.
 - a. Adhesive: Typical contact-type adhesive used for fully-adhered membranes.
 - b. Lap Sealant: Typical silicone lap and termination sealant used for membrane edges recommended by manufacturer.
 - c. Termination bars and fasteners: Stainless steel.
11. Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors: Low modulus silicone sheet; provide manufacturer's standard system consisting of pre-cured low-modulus silicone extrusion, in sizes to fit

widths indicated, combined with a neutral-curing low modulus silicone sealant for bonding extrusions to substrates.

- a. Tremco Extruded Silicone Sheet or Spectrem EZ Seal by Tremco, Inc.
- b. Bondaflex™ Silbridge 300 by May National Associates, Inc.
12. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes by SRAB air/vapor barrier manufacturer.
13. Stainless-Steel Sheet Flashing: ASTM A167, Type 304, soft annealed, with No. 2D finish; minimum, 0.0156 inch (0.4 mm) thick.
14. Transition Strip: Smooth surfaced SBS modified bitumen membrane, nominal 1 mm (40 mil) thickness, width as required.
 - a. Blueskin® SA as manufactured by Henry Company Inc.
 - b. Vycor V-40 Weather Barrier Strips, by Grace Construction Products
 - c. Perm-A-Barrier Wall Membrane, by Grace Construction Products
 - d. Rub-R-Wall SA self-adhering, smooth surfaced SBS
 - e. Air-Shield™ by W.R. Meadows, Inc.
 - f. CCW-705 or CCW Window & Door Flashing by Carlisle Coatings and Waterproofing.
 - g. ExoAir™ 110 by Tremco, Inc.
 - h. Poly-Wall Crack Guard; Protective Coatings Technology, Inc.
15. Transition Strip Primer:
 - a. Blueskin® Primer as manufactured by Henry Company Inc.
 - b. Perm-A-Barrier® WB Primer by Grace Construction Products.
 - c. Rub-R-Wall SA primer by RPC.
 - d. Mel-Prime VOC or Mel-Primer Water-Based Primer by W.R. Meadows
 - e. CCW-702 Solvent-Based Primer or CCW-AWP Water-Based Primer by Carlisle Coatings & Waterproofing
 - f. ExoAir™ WB Primer or ExoAi™ GM (Glass-Mat) Primer or ExoAir™ Primer by Tremco, Inc.
 - g. Poly-Wall AirLok or AirLok Flex; Protective Coatings Technology, Inc.

16. Termination Mastic: Two part, elastomeric, trowel grade material designed for use with self-adhered membranes and tapes. 100 g/l max. VOC Content.
 - a. Bituthene Liquid Membrane manufactured by Grace Construction Products.
 - b. Pointing Mastic by W.R. Meadows, Inc.
17. Substrate Filler for Rub-R-Wall: Rub-R-Wall Mastic manufactured by Rubber Polymer Corporation.
18. Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Non-reinforced, cured chloroprene polymer sheet (neoprene) complying with ASTM D2000 Designation 2BC415 to 3BC620, 50 to 65 mils (1.3 to 1.6 mm) thick.
 - a. Adhesive: Typical contact-type adhesive used for fully-adhered membranes.
 - b. Lap Sealant: Typical urethane or silicone lap and termination sealant used for membrane edges recommended by manufacturer.
 - c. Termination bars and fasteners:
 - (1) Stainless steel.
19. Sheet Membrane Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Low modulus silicone sheet; provide manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit widths indicated, combined with a neutral-curing low modulus silicone sealant for bonding extrusions to substrates.
 - a. Tremco Extruded Silicone Sheet or Spectrem EZ Seal by Tremco, Inc.
 - b. Bondaflex™ Silbridge 300 by May National Associates, Inc.
- B. Provide sealants in accordance with Section 07900 - Joint Sealers. Comply with ASTM C920 and ASTM C920 classifications for type, grade, class, and uses. Furnish sealants and joint sealers recommended by air/vapor barrier manufacturer for intended use and compatible with the air/vapor barrier membrane.
 1. Silicone Sealant [Type A];, natural cure, low modulus, to seal sheet membrane flashing to polyethylene face of sheet rubberized-asphalt barrier and to seal between and to non-bituminous sheet systems.
 - a. Acceptable Materials
 - (1) Spectrem® 1 or equivalent by Tremco, Inc.

- (2) Bondaflex™ Sil 290 by May National Associates, Inc.
- 2. Butyl Sealant Type B: butyl rubber base, single component, solvent release, non-skinning, Shore "A" Hardness Range of 10 to 30; black in color.
 - a. Acceptable materials:
 - (1) Butyl Sealant by Tremco Inc.
- 3. Sealant Type C: single component, , (comment: single components are not chemically curing) capable of continuous water immersion, non-sagging type, Shore "A" Hardness Range of 20 to 35 black in color.
 - a. Acceptable materials:
 - (1) Vulkem® 116 by Tremco Inc.
 - (2) Deck-O-Seal® One Step® by W.R. Meadows, Inc.
- 4. Polyurethane Sealant Type D: multi- component, chemical curing, non-sagging, Shore 'A' Hardness Range of 20 to 35, black in color.
 - a. Acceptable materials:
 - (1) Dymeric 240/240FC by Tremco Inc.
 - (2) CCW-201 by Carlisle Coatings and Waterproofing
- 5. Silicone Sealant Type E: single component, solvent curing, non-sagging, Shore 'A' Hardness Range of 35 to 45, black color.
 - a. Acceptable materials:
 - (1) Bondaflex™ Sil 100 by May National Associates, Inc.
- 6. Polyurethane Foam Sealant: Provide one-component or two-component, foamed-in-place, polyurethane foam sealant with the following characteristics:
 - (1) Density: 1.5 to 2.5 PCF.
 - (2) Flame Spread (ASTM E 84): 25 or less @ the application bead diameter.
 - (3) Initial R-Value (at 1 inch): Not less than 3.5
 - (4) Air Permeance (ASTM E 283) <0.02 L/s/m @ 75 Pa

Acceptable materials:

 - (a) Zerodraft Foam Sealant or Zerodraft Insulating Air Sealant by Zerodraft Division of Canam Building Envelope Specialists, Inc.

- (b) These one-component foam sealants by Dow Chemical: Great Stuff, Great Stuff Pro, ENERFoam, Great Stuff Pro or Window and Door Insulating Foam Sealant
 - (c) These two-component foam sealants by Dow Chemical: Froth-Pak or Froth Pack <25 FS
- 7. Primer: Recommended by sealant manufacturer.
- 8. Substrate Cleaner: Non-corrosive type recommended by sealant manufacturer.
- 9. Semi-Rigid Jamb Flashing: Calcium filled polypropylene extrusion to provide flashing at window, door, curtainwall and storefront jambs and used in conjunction with sealant materials and spray polyurethane foam materials to provide water, vapor and air seal at jambs.
 - a. Jamflash® by Lennel Specialties Corporation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions under which air/vapor barrier systems will be applied, with Installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 1. Do not proceed with installation until after minimum concrete curing period recommended by air/vapor barrier manufacturer.
 - 2. Ensure that:
 - a. surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
 - b. concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
 - c. masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
 - 3. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
 - 4. Notify Architect in writing of anticipated problems using air/vapor barrier over substrate.

3.02 SURFACE PREPARATION

A. Substrate Preparation for Air and Vapor Barrier Applications

1. Refer to Air and Vapor Barriers manufacturer's literature for more specific requirements of preparation of substrates.
2. Surfaces shall be free of contaminants such as grease, oil and wax on surfaces to receive membrane.
3. The CMU surfaces should be smooth and free from projections.
4. Strike all mortar joints full and flush to the face of the concrete block.
5. Fill all voids and holes greater than 1/2 inch.
6. Surface irregularities 1/8 inch in height or sharp to touch should be made smooth.
7. All penetrations should be grouted or filled.
8. If the surfaces cannot be made smooth to the satisfaction of the Architect, it will be the responsibility of the trade to alternatively apply a parge coat (typically one part cement to three parts sand) over the entire surface to receive Air Barrier Membrane.
9. Remove mortar droppings on brick ties, shelf angles, brick shelves or other horizontal obstructions.

B. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.

C. Prime substrates with conditioning primer when installing modified asphalt membrane transition membranes.

D. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond to transition membranes, with adequate drying time between coats.

E. Prime wood, metal, and painted substrates with primer recommended by membrane manufacturer.

F. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air/vapor barrier and at protrusions according to air/vapor barrier manufacturer's written instructions [and approved tested system in accordance with ABAA air barrier testing procedures].

G. Tape joints in exterior gypsum sheathing with reinforced or mesh style dry wall tape acceptable to manufacturer.

- H. Fill joints greater than ¼" between exterior gypsum sheathing panels with sealant or caulk acceptable to manufacturer.

3.03 INSTALLATION

1. Air Bloc 06:
2. Install materials according to the manufacturers instructions.
3. Transition joints: Prior to the application of the Air Bloc 06, seal transitions with Blueskin SA transition strip at beams, columns, changes in substrate material, and similar joints or connections to provide continuity of air/vapor barrier assembly. Generally, apply transition strips so that a minimum of 3" coverage is achieved over both substrates. Position strip over firm bearing.
4. Window frame perimeter, and doorframes: Lap transition strip from wall substrate with 3" of full contact over firm bearing to window or doorframe with 1" of full contact.
5. Apply air/vapor barrier membrane within recommended application temperature ranges. Consult manufacturer when membrane cannot be applied within these temperature ranges.
6. Apply by flat trowel (or air assisted spray equipment) a continuous unbroken film at a wet film thickness of 1/8" (3 mm) to the substrate.
7. Overlap Blueskin SA transition membrane a minimum of 1" (25 mm).

B. Air Bloc 21

1. Install materials according to manufacturers instructions.
2. Transition joints: Prior to the application of the Air Bloc 21, seal transitions with Blueskin SA transition strip at beams, columns, changes in substrate material, and similar joints or connections to provide continuity of air/vapor barrier assembly. Generally, apply transition strips so that a minimum of 3" (75mm) coverage is achieved over both substrates. Position strip over firm bearing.
3. Window frame perimeter, and doorframes: Lap transition strip from wall substrate with 3"(75mm) of full contact over firm bearing to window or doorframe with 1" (25mm) of full contact.
4. Apply air/vapor barrier membrane within recommended application temperature ranges. Consult manufacturer when membrane cannot be applied within these temperature ranges.
5. Apply Air Bloc 21 by flat trowel (or air assisted spray equipment if using Air Bloc 21 S) a continuous unbroken film at a wet film thickness of 1/8" (3 mm) to the substrate. Imbed insulation as work progresses

6. Ensure that Air Bloc 21 is applied in full contact around protrusions such as brick ties.
7. Overlap Blueskin SA transition membrane a minimum of 1" (25 mm).

C. Air-Shield LM

1. Install materials according to manufacturers instructions.
2. Transition joints: Prior to the application of the Air-Shield LM, seal transitions with Air-Shield transition strip at beams, columns, changes in substrate material, and similar joints or connections to provide continuity of air/vapor barrier assembly. Generally, apply transition strips so that a minimum of 3" (75mm) coverage is achieved over both substrates. Position strip over firm bearing.
3. Window frame perimeter, and doorframes: Lap transition strip from wall substrate with 3"(75mm) of full contact over firm bearing to window or doorframe with 1" (25mm) of full contact.
4. Apply air/vapor barrier membrane within recommended application temperature ranges. Consult manufacturer when membrane cannot be applied within these temperature ranges. In extremely hot weather, two coats (30 mils wet) are necessary.
5. Apply Air-Shield LM by air assisted spray equipment, a continuous unbroken film at a dry film thickness of 45 mils to the substrate.
6. Ensure that Air-Shield is applied in full contact around protrusions such as brick ties. On concrete block, ensure film thickness is attained on the highest profiles.
7. Overlap Air-Shield transition membrane a minimum of 1" (25 mm).

D. Rub-R-Wall

1. Install materials in accordance with manufacturer's instructions.
2. Transition joints: Seal with transition strip at beams, columns, changes in substrate material, and similar joints or connections to provide continuity of air/vapor barrier assembly. Generally, apply transition strips so that a minimum of 3" (75 mm) coverage is achieved over both substrates. Position strip over firm bearing.
3. Window frame perimeter, and doorframes: Lap transition strip from wall substrate with 3"(75 mm) of full contact over firm bearing to window or doorframe with 1"(25 mm) of full contact.
4. Apply air/vapor barrier membrane within recommended application temperature ranges. Consult manufacturer when membrane cannot be applied within these temperature ranges.

5. Using airless spray equipment having a minimum pressure of 3000 psi, apply prime coat of air/vapor barrier membrane over outer surface of inner wythe masonry.
6. Use alternating horizontal and vertical passes to ensure complete coverage of substrate and transition strips. Seal masonry anchors or other penetrations air tight.
7. Check surfaces again and if necessary, fill any remaining gaps with mastic substrate filler prior to covering with membrane.
8. Complete application of membrane to provide a seamless, monolithic surface to a dry film thickness (DFT) of 60 mils over smooth surfaces such as gypsum sheathing and over prepared masonry and concrete surfaces.
9. Adhere insulation to air/vapor barrier membrane after initial set time of approximately 1 to 2 hours, and while membrane is still tacky, to prevent convection currents occurring behind the insulation, and seal all board-to-board joints with liquid membrane.

E. Perm A Barrier Liquid®

1. Exterior sheathing panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws. Pre-treat all board joints with 50 - 75mm (2-3 in.) wide, reinforced self-adhesive tape or fiberglass mesh style wallboard tape. Gaps greater than 6mm (1/4 in.) should be filled with mastic or caulk, allowing sufficient time to fully cure before application of the tape and liquid membrane.
2. Masonry Substrates: Apply liquid membrane over concrete block and brick with smooth trowel-cut mortar joints. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout or parge coat.
3. Related Materials: Treat construction joints and install flashing as recommended by manufacturer.
4. Refer to manufacturer's literature for recommendations on installation
5. Application of Fluid Applied Membrane
 - a. Spray or trowel apply a continuous uniform film at 60 mils (1.5mm) wet film thickness using multiple, overlapping passes to achieve a 60 mil dry film thickness (DFT).
 - b. When spraying use a cross-hatching technique (alternating horizontal and vertical passes) to ensure even thickness and coverage.
 - c. When spraying use high pressure, multi-component, airless spray equipment approved by material manufacturer.

- d. Carry membrane into any openings a minimum of 50mm (2")
- e. Seal all brick-ties and other penetrations as work progresses

F. Application of Transition Membrane for Perm A Barrier Liquid®

1. After allowing the Fluid Applied Membrane to cure to tack-free, apply transition membrane with a minimum overlap of 75mm (3") onto each surface at all beams, columns and joints as indicated in detail drawings.
2. Tie in to window and door frames, spandrel panels, roof and floor intersections and changes in substrate.
3. Use pre-cut, easily handled lengths for each location.
4. Remove silicone-coated release paper and position flashing carefully before placing it against the surface.
5. When properly positioned, place against surface by pressing firmly into place by hand roller.
6. Overlap adjacent pieces 50 mm (2") and roll all seams with a hand roller.
7. Seal top edge and all cut edges of transition membranes and flashing with termination mastic
 - a. Apply liquid membrane to all fastener heads, overlapping board by 1".

G. Barriseal Liquid-Applied Air/Vapor Barrier

1. Verify condition of and/or prepare surface in accordance with manufacturer's instructions
2. Detail all terminations, transitions, joints and seams with CCW-705, CCW-705 TWF, PreKleend EPDM, CCW Window & Door Flashing, CCW EZ Flash W&D and/or CCW WillFlash Molded Corner Flashing according to manufacturer's instructions.
3. Spray (Barriseal-S) or roll (Barriseal-R) in a continuous and uniform coating at 40 mils cured thickness. Apply Barriseal coating over/onto detail flashings. Refer to manufacturer's instructions.
4. Inspect Barriseal membrane before covering. Repair any tears or holes with Barriseal-R applied at 40 mils cured thickness over damaged area.
5. Inspect detail flashings before covering. Repair any tears or holes with patches made from CCW-705, CCW 705 TWF or CCW Window and Door Flashing. Overlap repair patch a minimum of 5" in the vertical direction and 2-1/2" in the horizontal direction beyond the damaged area. Seal perimeter of repair patch with a continuous bead of CCW-704 mastic.

H. ExoAir™ 120 Fluid-Applied Air/Vapor Barrier

1. Refer to the Manufacturer's Literature for recommendations on installation.
2. Apply detail flashings and sealants prior to spraying according to Manufacturer's instructions.
3. Spray a continuous uniform film of ExoAir™ 120 at 60 mils (1.5mm) min. wet film thickness using multiple, overlapping passes. When spraying use a cross-hatching technique (alternating horizontal and vertical passes) to ensure even thickness and coverage. When spraying use high pressure, airless spray equipment approved by Tremco. Seal all brick-ties and other penetrations with ExoAir™ 120 or TREMproof 201T as appropriate and as work progresses. Carry ExoAi™ 120 a minimum of 3" (75mm) onto the ExoAir™ 110/110LT transition and ExoAir™ TWF membranes. Review final ExoAir 120 application to ensure all substrates have been fully coated, and that there are no passages remaining for air infiltration / exfiltration, water vapor transmission or water penetration.
4. Inspect the ExoAir™ 120 membrane before covering and repair any punctures or damaged areas with ExoAir 120, TREMproof 201T or other pre-approved Tremco mastic, extending repair material a minimum of 6" (152mm) beyond the puncture or damage..
5. Inspect ExoAi™r 110/110LT and ExoAir TWF membranes before covering and repair any punctures or damaged areas. Make repairs with ExoAir™ 110/110LT or ExoAir™ TWF as appropriate or Tremproof 201T or other pre-approved Tremco mastic extending either repair material 6" [152 mm] beyond the puncture or damage.

I. Poly-Wall AirLok or AirLok Flex

1. Prepare surfaces and install materials according to manufacturer's instructions.
2. Apply air/vapor barrier membranes with sprayer or roller in one coat. Coat to protrusions such as brick ties and metal flashings to form a seal at their intersection.
3. Transition joints: After the application of AirLok or AirLok Flex, seal transition joints with Crack Guard to provide continuity. Apply strips so such that there is a minimum 2.5 inch overlap.
4. Window and door frames may be installed after air/vapor barrier membrane are applied. After frames are installed, install Crack Guard transition strip such that a minimum 2.5 inch contact with wall structure and 1 inch contact with frame.
5. Insulation may be installed anytime after coating is dry.

J. Window Frame and Doorframes

1. Prime all surfaces. Lap transition strip from wall substrate with 3" of full contact over firm bearing to window or doorframe with 1" of full contact. Use roller to secure membrane adhesion (SRAB transition strip). Apply adhesive to wall, frame and membrane. Install membrane and termination bars, fastened 6" o.c. Use lap sealant over exposed edges and on cavity side (neoprene).
2. Apply foam sealant for gaps up to 2" (50 mm) in width or insulating foam sealant for gaps greater than 2" (50 mm) to:
 - a. Window, door, curtainwall and storefront perimeters
 - b. Miscellaneous penetrations of the air barrier system in accordance with the manufacturer's instructions

- K. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.04 PROTECTING AND CLEANING

- A. Protect air/vapor barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Protect air/vapor barrier from exposure to the elements as required by the manufacturer. Remove any masking materials after installation. Clean any stains on materials that would be exposed in the completed work using procedures as recommended by manufacturer.
 1. Protect membranes to avoid damage from other trades, and construction materials during subsequent operations as recommended by manufacturer. Seal all joints of the insulation boards with spray polyurethane foam sealant.
 2. Schedule work to ensure that the air and vapor barrier system is covered as soon as possible after installation. Protect air and vapor barrier system from damage during subsequent operations. If the air and vapor barrier system cannot be permanently covered within 30 days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The description and extent of each type of joint sealer is indicated on the Drawings and specified herein. Specific applications include:
 - 1. Masonry wall joints.
 - 2. Flashing and coping joints.
 - 3. Interior wall/ceiling joints.
 - 4. Gasketing of assemblies.
 - 5. Door thresholds.
 - 6. Door and window frames.

1.02 RELATED WORK NOT INCLUDED

- A. Concrete work, including joints and sealants, is included in Division 3.
- B. Unit masonry is included in Division 4.
- C. Glazing is included in Division 8.
- D. Doors and windows are included in Division 8.

1.03 QUALITY ASSURANCE

- A. General Performance: Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

1.04 SUBMITTALS

- A. Product Data
 - 1. Submit manufacturer's product specifications, handling/installation/curing instructions, and performance tested data sheets for each elastomeric product required, in accordance with Division 1, Section 00700 (00710).

B. Certified Tests

1. With product data, submit certified test reports for elastomeric sealants on aged performances as specified, including hardness, stain resistance, adhesion, cohesion or tensile strength, elongation, low-temperature flexibility, compression set, modulus of elasticity, water absorption, and resistance (aging, weight loss, deterioration) to heat and exposure to ozone and ultraviolet.

PART 2 PRODUCTS

2.01 CAULKING COMPOUND AND ACCESSORIES

A. Caulking Compound

1. Caulking compound shall be Sonolastic NP1 or NP2 as manufactured by Sonneborn-Contech Inc. or equivalent by W. R. Grace Co. Color shall be light gray throughout unless noted on Drawings.

B. Primer

1. For water immersion, prime with Sonneborn-Contech Primer No. 733 for concrete and masonry, and Primer No. 758 for glass and metals.

C. Joint Filler and Bond Breaker

1. Where additional sealant backing is needed to control the depth of sealant in relation to joint width. Use Sonneborn Sonofoam Backer-Rod (closed cell polyethylene foam) or equivalent W.R. Grace Co. products, or equal.

PART 3 EXECUTION

3.01 INSTALLATION OF CAULKING COMPOUNDS AND ACCESSORIES

- A. Caulking compound shall completely seal all joints around frames and sills of doors, windows and other openings in masonry and concrete walls, and all other joints or spaces noted on the Drawings to be caulked. Set door thresholds in full bed of caulking compound. All caulking compound, primer and joint filler shall be installed in strict accordance with the manufacturer's printed instructions, which shall be available at the job site. Refer to Division 3 for special joint requirements in connection with precast and prestressed structural concrete members.
- B. All joint surfaces must be dry, thoroughly clean and primed as recommended by the caulking manufacturer. Apply primer with a brush or clean cloth in sufficient amount to obtain 100 percent coverage. Best results are obtained when primer is applied in a thin coat for most surfaces; however, porous surfaces require a somewhat heavier but not excessive coat. Allow primer to dry for the recommended period before applying sealant.

- C. The depth of sealant shall be $\frac{1}{2}$ the width of the joint, with a maximum depth of $\frac{1}{2}$ inches and a minimum of $\frac{1}{4}$ inches. Joint depths exceeding this design criteria should be filled to the proper depth using a joint filler or backup material such as a backer-rod, which should be about $\frac{1}{8}$ -inch larger in diameter than the width of the joint to allow for compression. Where the joint is too small to permit a backer-rod, a polyethylene film strip must be used to prevent the sealant bonding to joint filler.
- D. Caulking can be applied with a bulk or air powered caulking gun. See manufacturer's recommendations for minimum temperature at which caulking can be applied.
- E. See manufacturer's instructions for application to masonry, metal, glass, and wood.
- F. Remove excess caulking and leave surface neat, smooth and clean. All caulked joints shall be watertight.

END OF SECTION

SECTION 08120
ALUMINUM FLUSH DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cross Aluminum Flush Doors.
- B. Aluminum Door Frames

1.02 RELATED SECTIONS

- A. Section 04200: Masonry (Frame Installation)
- B. Section 07900: Joint Sealers
- C. Section 08710: Door Hardware
- D. Section 09900: Field Painting

1.03 REFERENCES

- A. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM B 308 - Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- D. ASTM E 283 - Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- E. ASTM E 330 - Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- F. ASTM E 331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- G. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- H. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

1.04 SYSTEM DESCRIPTION

A. System Performance Requirements:

1. Air infiltration: When tested in accordance with ASTM E 283, the air infiltration should not exceed .04 cfm per square foot of fixed area.
2. Water Penetration: No water will pass through the entry system when tested in accordance with ASTM E 331 at a pressure of 6.24.
3. Uniform Load Deflection: Entry system shall be tested in accordance with ASTM E 330: 3840 Pa or 80.0 psf positive and negative.
4. Uniform Load Structural: Entry system shall be tested in accordance with ASTM E 330: 5760 Pa or 120.0 psf positive and negative.
5. Missile Impact: Entry system will pass double impact from large missile; ASTM E 1886.

1.05 SUBMITTALS

A. General: Refer to Submittal Procedures – Section 00700/00710

B. Product Data: Include manufacturer's product information, including material, elemental construction, fabrication, and finishes.

C. Shop Drawings: Include shop drawings relating to dimensions, fabrication, finish and installation.

1. Drawings should include the following:
 - a. Dimensions
 - b. Elevations with necessary detail keys
 - c. Entry system reinforcements (if applicable)
 - d. Fabrication and Finish

D. Samples:

1. Color: Provide manufacturer's samples of standard and non-standard finishes.
2. Door: Supply manufacturer's door sample presenting finish, interior insulation, and standard reinforcement components.

E. Test Results: Offer any required test results for particular jobs. Accredited test reports will be available upon request.

F. Manufacturer's Instructions: Provide all necessary instructions for installation including glazing, anchoring, reinforcement (if applicable), and optimum performance installation.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturing process with contemporary inspection using neoteric checklist for optimum field performance.
2. Manufacturing same product specified for over 25 years.

B. Pre-Installation Meetings: Plan initial pre-installation meetings for job details and regional regulations.

1.07 DELIVERY, STORAGE, HANDLING

A. Packing: Finished products shall be packaged securely with appropriate labeling for protection and product identification visible on packaging.

B. Shipping and Handling: Deliver materials to site in original condition and packaging without any damage to packaging or materials.

C. Unloading: Individually packaged products to be unloaded by hand truck or 2-person team lift (or more if needed) to avoid unnecessary damage.

D. Storage and Protection:

1. Store items indoors away from excessive amounts of moisture.
2. Protect entry doors against damage from outdoor hazards and during the entire installation

E. Waste Management: Refer to contact information apparent on packaging for appropriate recycling opportunities.

1.08 WARRANTY

A. Warrant doors and frames to be free from defects and premature degradation of finish and door structure.

B. Warranty period will be ten years from the date of substantial completion.

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PART 2 PRODUCTS

2.01 MANUFACTURER

A. Cross Aluminum Products Inc.,
Address: 1770 Mayflower Rd., Niles, Michigan 49120.
Phone: (800) 806-3667 or (269) 697-8340
Fax: (269) 697-8348
Web: www.crossaluminum.com
Email: door@crossaluminum.com

B. An equal product.

2.02 ALUMINUM FLUSH DOORS

A. Product: FL-400 Series with required aluminum frames.

B. Door Opening Size: refer to drawings.

C. Door Assembly:

1. Door Stile: To be aluminum alloy 6063; temper to be T5 with a minimum 1/8" wall thickness.
2. Stile Thickness: To be 1 3/4" thick tubular extrusion.
3. Door Joinery: Joinery shall be 3/8" diameter cadmium tie rods bolted through interlocking stiles. Minimum of 3 tie rods per door (where applicable).
4. Top of Door: To receive added 1/8" reinforcement closer plate adhered to interior wall for door closer hardware.
5. Top/Bottom of Door: To receive 1/8" thick cap for further seal and to trim the top and bottom of door.

B. Pattern: Fluted or Smooth—match existing.

C. Insulation: Polyisocyanurate Rigid Foam

2.03 MATERIALS AND ACCESSORIES

A. Aluminum:

1. ASTM B 221, alloy and temper to be 6063 T-5 or similar alloy and temper recommended by manufacturer for optimum finish results and consistency.

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B. Internal Reinforcement

1. ASTM B 308, for structural aluminum.

C. Fasteners

1. Material: Aluminum, 18-8 Stainless Steel, or other non-corrosive materials compatible with items being screw applied.
2. Exposed:
 - a. Type: Fasteners exposed will be Philips flathead fasteners unless provided by other supplier.
 - b. Finish: Fasteners to match appropriate finish on standard doors and frames.
3. Concealed: To be standard according to manufacturer's standards.

D. Weatherstripping:

1. Wool pile:
 - a. Material: Solid Propylene Base with resilient fibers.
 - b. Color: Manufacturer's standard black color.

E. Glazing: None

2.04 HARDWARE

- A. Hardware Preparation: To be fabricated at factory according to hardware templates provided.
- B. Hardware Installation: To factory install all applicable and supplied hardware to doors and frames.
- C. Hardware Reinforcement: To provide necessary reinforcement for proper longevity and hardware function; ASTM B 209 and/or ASTM 308.
- D. See hardware requirements in Section 08710.
- E. Hardware Finish: Clear

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2.05 FABRICATION

A. Processes:

1. Job Preparation:
 - a. Preliminary Analysis: Job drawings to indicate door types, sizes, vision lite configuration(s), and finishes.
 - b. Fulfill Custom Requirements: Follow through on any specific deviations from standard requirements.
2. Assembly:
 - a. Product Operation: Measure, cut, and fabricate required materials for designated job.
 - b. Product Refinement: Smooth rough cut edges.
 - c. Arrangement: Place prepared structural fasteners inside door to conceal from view.
 - d. Reinforcement Preparation: To apply necessary structural and hardware reinforcement in beneficial areas of doors and frames where needed.
3. Fitting:
 - a. Placement: Product materials to fit accurately in appropriate locations.
 - b. Alignment: Doors to be in proper alignment with intended elevations.

- B. Tolerances: Doors and/or frame elevations will not deviate from last revised and approved drawings.

2.06 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard aluminum extruded profiles with required thickness for load support.

1. Vertical Jamb Sizes: 1 3/4" x 4 1/2" or 2" x 6 1/2" as needed/as shown on the drawings.
2. Header Sizes: 1 3/4" x 4 1/2" or 2" x 4 1/2" as needed/as shown on the drawings.

- B. Clips and Reinforcements: Manufacturer's standard high strength aluminum: ASTM B 221 and/or ASTM B 308.

C. Fasteners and Accessories: Manufacturer's standard non-bleeding and non-corrosive material congruent to adjacent material.

1. Exposed Fasteners: To be stainless steel Philips flathead screws with appropriate finish: ASME B 18.6.4
2. Concealed Fasteners: To be manufacturer's standard.

D. Assembly:

1. Framing members are separate aluminum pieces cut to length and mechanically fastened from either spline or clip systems.
2. Joinery to be hairline.
3. Sommer and Maca Dymonic or Dow Corning® 795 Sealants applied on applicable areas.
4. Framing elevations to be identified according to final approved drawings.

E. Anchoring:

1. Appropriate anchoring fasteners to be secured no more than 18" apart on entire frame opening.
2. Frame headers to receive no less than 2 anchoring fasteners.
3. Add extra fasteners where hardware and hinge may require more.

F. Doorstop:

1. To be #CDM-32.
 - a. Wall Thickness: To be 3/16" thick for receiving applicable hardware.
 - b. Profile Height: To be no less than 5/8" high.
2. Snap-in: Fits standard manufacturer's door jamb profiles.
3. To receive weather strip around acting door leafs.
 - a. Wool pile: Solid Propylene Base with resilient fibers in a standard black color.

G. Hardware Preparation:

1. Intramural Work: Hardware preparation according to hardware suppliers' templates.

2. Field Work: Refer to manufacturers' installation instructions.

H. Side lites and Transoms:

1. Factory-assembled to largest allowable shipping size.
2. Identified in concealed locations according to final approved elevation numbers.

2.07 FINISHES

A. Anodic Finishes:

1. Clear 215 R1: Architectural Class 1, AA-M12C22A41, 0.7 mils.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting proper installation.

3.02 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Do not install damaged components.
- C. Install doors plumb, level, and square, with no warp or rack in frame.
- D. Hang doors with the following required clearances:
1. Lock Stiles: 0.125"
 2. Between Meeting Stiles: 0.187" - 0.250"
 3. At Top Rails: 0.125"
 4. Between Bottom Rail and Threshold: 0.125" - 0.187"
- E. Fit joints to produce hairline joints free of burrs and distortion.
- F. Rigidly secure non movement joints.
- G. Install recommended anchors with separators to prevent metal corrosion and electrolytic deterioration.
- H. Seal joints watertight, unless otherwise indicated.

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- I. Place thresholds in proper weather sealant.

3.03 ADJUSTING

- A. Fine-tune doors and hinges to operate properly without bind or sag.
- B. Adjust pressure settings on closers.
 - 1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

3.04 CLEANING

- A. Immediately clean doors after installation.
- B. Avoid any harsh cleaners not specified on manufacturer's cleaning and care guide.

3.05 PROTECTION

- A. Follow manufacturer's guide to cleaning and care for proper treatment on entrances for optimum longevity, function, and performance.

END OF SECTION

SECTION 08710
DOOR HARDWARE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for hollow metal swinging doors.
- B. Related Sections include the following:
 - 1. Division 08 Section "Hollow Metal Doors and Frames" for astragals provided as part of fire-rated labeled assemblies and for door silencers provided as part of hollow-metal frames.

1.03 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes. B. Qualification Data:
 - 1. Finish Hardware Installers
 - a. Finish hardware, including electrified hardware, for wood, hollow metal, and aluminum doors to be installed by personnel trained and certified by the manufacturer of the product furnished.
 - b. Provide manufacturer's certificates for installer as part of Contractor's bid information. Failure to supply certificates may result in rejection of bid.
 - 2. Hardware Supplier
 - a. Established contract hardware firm which maintains and operates an office, display, and stock in project area and which is a factory authorized distributor of the lock being furnished.
 - b. Hardware scheduled and furnished by or under direct supervision an Architectural Hardware Consultant.
 - c. All schedules submitted to the Architect for approval and job use must carry the signature and certified seal of this Architectural Hardware Consultant.

3. Architectural Hardware Consultant
 - a. Currently certified by the Door and Hardware Institute.
 - b. Full-time employee of the Hardware Supplier or an individual having no contractual ties to any supplier/manufacturer entity.
 - c. Available at reasonable times to Architect, Owner, and Contractor during course of work.
- B. Maintenance Data: For each type of door hardware. Include final hardware schedule, product data sheets, keying schedule, in 3-ring binder, labeled on spine with project name and "Door Hardware".
- C. Warranty: Special warranty specified in this Section.
- D. Other Action Submittals:
 1. Door Hardware Sets: Prepared by or under the supervision of a DHI certified Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule"; other formats will be rejected without review. Double space entries, and number and date each page.
 - b. Numerical Sequence of Sets and Headings: Submittal headings shall be in exact order as hardware sets in specification: one heading only per set. Submittal set numbers shall relate to specification set numbers, i.e. if three headings are required for Set 12 due to door width differences, then the heading numbers should be 12.1, 12.2, and 12.3 or employing similar linking logic.
 - c. Number of Copies: (5).
 - d. Content: Include the following information:
 - (1) Identification number, location, hand, fire rating, and material of each door and frame.
 - (2) Type, style, function, size, quantity, and finish of each door hardware item.
 - (3) Complete designations of every item required for each door or opening including name and manufacturer.
 - (4) Degree of opening for closer and overhead stop and holder installation.

- (5) Keying information.
 - (6) Fastenings and other pertinent information.
 - (7) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - (8) Explanation of abbreviations, symbols, and codes contained in schedule.
 - (9) Mounting locations for door hardware.
 - (10) Notes included with specification hardware sets transcribed verbatim into submittal hardware sets.
 - (11) Door and frame sizes and materials.
 - (12) List of related door devices specified in other Sections for each door and frame.
- e. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.
2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.04 QUALITY ASSURANCE

- A. Furnish proper hardware types and quantities for door function, hardware mounting and clearances, and to meet applicable codes. Bring discrepancies to the attention of the Architect a minimum of (10) days prior to bid date so that an addendum may be issued. No additional compensation will be allowed after bidding for hardware changes required for proper function, hardware mounting or clearances, or to meet codes.
- B. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated. If hardware is obtained from more than one supplier, the GC is still responsible for making sure that each product

type is by the same manufacturer and series. Storefront hardware must match builder's hardware. For instance, if the contract hardware supplier furnishes Norton 7500 series closers for the wood and hollow metal doors, then the storefront supplier must furnish Norton 7500 series closers for the aluminum storefront doors; same procedure holds for exit devices, continuous hinges, closers, pivots, pulls, push bars, locksets, and key cylinders.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 or UBC Standard 7-2.

1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.

E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner, Contractor, and Architect, conference participants shall also include Hardware Supplier's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to Owner by registered mail or overnight package service. Obtain Owner's contact name and address from Architect.

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1.06 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Distribute templates in a timely manner so as not to delay suppliers. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Five years from date of Substantial Completion, except as follows:
 - a. Manual Closers: 10 years from date of Substantial Completion.

1.08 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 PRODUCTS

Products and manufacturers are not limited to any listed below. "Equal" products will be considered. Manufacturers wishing to have products considered, please submit product literature to architect ten days prior to bid.

2.01 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

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1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers specified.

2.02 BUTT HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
 2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
 3. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
 4. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Height, Width, and Weight: Unless otherwise indicated, provide the following:
1. Doors 3'6" or more in width: 5" high, heavy-weight hinges.

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2. Doors less than 3'6" in width: 4-1/2" high, standard-weight hinges.
3. Width: 4-1/2" heavy-weight, 4" standard-weight, unless proper clearance requires a different width.
4. Doors with Closers: Antifriction-bearing hinges.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior and in-swinging restroom door hinges: Stainless steel, with stainless-steel pin.
2. Balance of hinges: Steel, with steel pin. E. Hinge Options: Provide the following:
3. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for reverse bevel lockable doors.
4. Corners: Square.
5. Number of knuckles: Five.

E. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
4. Screws: Phillips flat-head. Finish screw heads to match surface of hinges.

F. Template Hinge Dimensions: BHMA A156.7.

G. Available Manufacturers:

1. Bommer Industries, Inc. (BI).
2. Hager Companies (HAG).
3. McKinney Products Company; an ASSA ABLOY Group company (MCK).
4. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
5. AUB, Inc. (AUB)

2.03 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural and Transportation Barriers

Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
 1. Levers: Cast Yale AU model with full angled return.
 2. Dummy Trim: Match lever lock trim and roses.
 3. Lockset Designs: Provide design indicated in hardware sets, or, if sets are provided by another manufacturer, provide designs that match those designated.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
- E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
 1. Strikes for Bored Locks and Latches: BHMA A156.2.

2.04 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 1. Bored Locks: BHMA A156.2.
- B. Bored Locks: BHMA A156.2 Grade 1.
 1. Available Manufacturers:
 - a. Best Access Systems; Div. of The Stanley Works (BAS).
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - c. Hager. (HAG).

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- d. SARGENT Manufacturing Company; an ASSA ABLOY Group company
- e. (SGT).
- f. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
- g. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

C. Compatibility with Key Cylinders: fully warranted for use with key cylinder furnished.

2.05 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

- 1. Surface Bolts: Minimum 1-1/8-inch (29-mm) throw.

B. Surface Bolts: BHMA A156.16, Grade 1.

- 1. Surface Bolt Heads: Minimum of 1/4-inch (6mm) x 3/4-inch (19-mm) bolts of stainless steel with minimum 12-inch (305-mm) long rod for doors up to 84 inches (2134 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2134 mm).
- 2. Surface bolts shall include the manufacturer's standard top strike and mortise bottom strike, finish to match the hardware.
- 3. Provide sex bolts.
- 4. Available Manufacturers:
 - a. ABH Manufacturing.
 - b. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
 - c. Hager Companies (HAG).
 - d. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - e. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - f. Rockwood Manufacturing Company (RM).
 - g. Trimco (TBM).

2.06 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1.
- B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural and Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. Outside Trim: As specified in hardware sets; material and finish to match locksets, unless otherwise indicated.
 - 1. Match design for locksets and latch sets, unless otherwise indicated.
- G. Fasteners. Manufacturer's standard, except furnish sex bolts for attachments to doors.
- H. Shims: Provide shims if needed for clearance.
- I. Available Manufacturers:
 - 1. Detex, Inc. (DTX)
 - 2. Precision Hardware, Inc. (PH).

2.07 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1.
- B. Cylinders: Provide cylinders for all devices requiring key cylinders to properly function: constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Six.

2. Keyway: Standard Best; as directed by Owner.
 3. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 4. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 5. Bored-Lock Type: Cylinders with tailpieces to suit locks.
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
1. Small-format Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- D. Construction Keying: Comply with the following:
1. Construction Cores: Provide keyed brass construction cores that are replaceable by permanent cores for locking devices on exterior doors. Provide 6 construction master keys.
 - a. Replace construction cores with permanent cores as directed by Owner.
- E. Supplemental Items: Provide cylinder spacers, collars, and correct cams as needed for proper function of locking devices.
- F. Available Manufacturers:
1. Best Access Systems; Div. of The Stanley Works (BAS).
 2. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company
 3. (CR).
 4. SARGENT Manufacturing Company; an ASSA ABLOY Group company
 5. (SGT).
 6. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
 7. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company
 8. (YAL).
 9. Marshall Best Security (MBS).
 10. Hager.

2.08 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:
 - 1. Match existing Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 - 2. Quantity: Provide the following:
 - a. Cylinder Change Keys: Three per cylinder.
 - b. Master Keys: Six per master.
 - c. Grand Master Keys: Six.
 - d. Control Keys: Two.
 - e. Construction Control Keys: Two.
 - f. Blanks: Twenty.

2.09 SURFACE CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
- C. Fasteners: Manufacturer's standard for arms, shoes and brackets. Sex bolts for fastening closers to doors.

- D. Mounting Accessories: Provide shoes, brackets, drop plates, spacers, etc., as needed for proper mounting of closers and arms to door and frame.
- E. Spring Size of Units: Provide field-sizable closers, adjustable for spring sizes 1-6, plus 50% extra spring power at spring size 6, to meet field conditions and requirements for opening force.
- F. Cylinders: 1-1/2" minimum diameter; cast iron or aluminum.
- G. Mounting Configuration: Unless otherwise indicated by model number in the hardware sets:
 - 1. Do not furnish closers capable of being mounted on the corridor side of doors.
 - 2. Do not furnish regular arm closers in areas accessible to students.
 - 3. If tri-pack closers are furnished for regular arm applications, remove parallel arm shoe from closer box before delivering to job.
 - 4. Parallel Arm closers are to be manufacturer's double forged rigid models.
- H. Available Manufacturers:
 - 5. LCN Closers; an Ingersoll-Rand Company (LCN).
 - 6. SARGENT Manufacturing Company; an ASSA ABLOY Group company
 - 7. (SGT).
 - 8. Stanley Commercial Hardware; Div. of The Stanley Works.
 - 9. Norton.
 - 10. Hager.

2.10 PROTECTIVE TRIM UNITS

- A. Size:
 - 1. Width
 - a. Singles, and pairs with removable mullions or surface applied astragals: 2 inches (38 mm) less than door width on push side and 1 inch (13 mm) less than door width on pull side
 - b. Other pairs: 1 inch (13 mm) less than door width
 - 2. Height: as specified in door hardware sets; or, if constrained by door bottom rail height, 1" less bottom rail height.
- B. Fasteners: Manufacturer's machine or self-tapping countersunk screws.
- C. Metal Protective Trim Units: BHMA A156.6; beveled 4 sides; fabricated from

D. 0.050-inch- (1.3-mm-) thick stainless steel. D. Available Manufacturers:

1. Hager Companies (HAG).
2. IVES Hardware; an Ingersoll-Rand Company (IVS).
3. McKinney Products Company; an ASSA ABLOY Group company (MCK).
4. Rockwood Manufacturing Company (RM).
5. Trimco (TBM).

2.11 MECHANICAL WALL AND FLOOR STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16, Grade 1.

1. Provide wall stops for doors unless floor, overhead, or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Provide floor stops (and spacers if needed) of proper height and configuration to accommodate floor condition. Where floor or wall stops are not appropriate, provide overhead holders.
2. Properties. Cast construction with fastener suitable for wall or floor condition.
3. Available Manufacturers:
 - a. Hager Companies (HAG).
 - b. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - c. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - d. Rockwood Manufacturing Company (RM).
 - e. Trimco (TBM).

B. Wall-mounted Combination Door Stops and Holders: BHMA A156.16, Grade 1.

1. Properties: Heavy cast with adjustable holding force, self-compensating for changes up to ¼" in vertical door position. Provide flush spacers finished to match adjoining substrates for clearance as needed.
2. Manufacturer and Model: Trimco 1283 or approved equal.

2.12 OVERHEAD STOPS AND HOLDERS

A. BHMA A156.8, Grade 1. Template for maximum degree of opening before encountering obstruction. B. Available Manufacturers:

1. Architectural Builders Hardware Mfg., Inc. (ABH).

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2. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
3. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
4. SARGENT Manufacturing Company; an ASSA ABLOY Group company
5. (SGT).

2.13 SILENCERS

- A. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.
- B. Available Manufacturers:
 1. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
 2. Hager Companies (HAG).
 3. IVES Hardware; an Ingersoll-Rand Company (IVS).
 4. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 5. Rockwood Manufacturing Company (RM).
 6. Trimco (TBM).

2.14 DOOR GASKETING

- A. General: Provide continuous weather-strip gasketing on exterior hollow metal doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners as indicated by models in hardware sets.
 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 3. Mullion Gasketing: Fasten to mullions, forming seal when doors are closed.
 4. Sweeps: Apply to bottom of in-swinging hollow metal doors, forming seal with threshold when door is closed.
 5. Seals integral to threshold at out-swinging exterior hollow metal doors.
- B. Requirements per type of rated door provided (these requirements supersede models indicated in hardware sets):
 1. Category A wood doors: provide models indicated in hardware sets.

2. Category B wood doors: provide NGP 9550 (or approved equal) Category G&H seals at jambs and meeting edges. If sound seals are indicated in hardware sets, provide the 9550 seals in addition to the sound seals.
3. Category A and B hollow metal doors: provide models indicated in hardware sets.
- C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.
- E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 or UBC Standard 7-2.
 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.
- F. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- G. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- H. Gasketing Materials:
 1. Adhesive Seals. As specified in hardware sets or approved equal.
 2. Intumescents: As required.
 3. Screwed-on weatherstrip and sweeps. Neoprene.
 4. Panic type thresholds. Neoprene or polyprene.
- I. Available Manufacturers:
 1. Hager Companies (HAG).
 2. National Guard Products (NGP).

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3. Pemko Manufacturing Co. (PEM).
4. Reese Enterprises (RE).

2.15 THRESHOLDS

- A. Standard: BHMA A156.21
- B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation
- C. Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
- D. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.
- E. Fasteners: ¼-20 machine screws and expansion anchors.
- F. Gasketing material: At panic-type thresholds: neoprene or polyprene.
- G. Available Manufacturers:
 1. Hager Companies (HAG).
 2. National Guard Products (NGP).
 3. Pemko Manufacturing Co. (PEM).
 4. Reese Enterprises (RE).
 5. Zero International (ZRO).

2.16 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Manufacturer's standard, except as noted in product sections of this specification.

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2.17 FINISHES

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

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

3.03 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- B. Mounting Locations:
 - 1. Floor Stops and Holders: Locate at least 20" out from hinge edge of door for maximum degree of opening before door encounters obstruction.
 - 2. Wall Stops: Locate so that lockset spindle and wall stop share horizontal and vertical centerlines.
 - 3. Wall Stop/Holders: Locate 4" down and in from top lock-edge corner of door w/holder slot at bottom of unit.

4. Closers and Overhead Stop/Holders: Template and mount closers and overhead stops for maximum degree of opening before door encounters obstruction. When used with closers, template and locate overhead stops so that closer arm does not fully extend and bottom out.
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface mounted items until finishes have been completed on substrates involved.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.04 FIELD QUALITY CONTROL

- A. Provide Door Hardware Inspection Services and Field Quality Report as indicated below.
- B. Door Hardware Inspection Services
 1. Scope
 - a. Inspection of all swinging doors and door hardware immediately following completion of installation.
 - b. Inspector to furnish a Field Quality Report, itemized per each individual opening, to the Architect within 7 days of the inspection, including:
 - (1) deficiencies in workmanship and standard industry practices,
 - (2) use of allowable products,
 - (3) use of manufacturer recommended fasteners,
 - (4) compliance with the ADA,
 - (5) proper door/frame/hardware clearances,
 - (6) problems related to function, security, aesthetics or maintenance.

- c. Payment to be made directly from GC to Inspector within 30 days of invoice. Re-inspections at additional fee until all problems are resolved.
- 2. Inspector Qualifications
 - a. Certified Architectural Hardware Consultant.
 - b. Entirely independent of the supply side of the project, having no familial or financial relationship with any manufacturer, manufacturer's representative, distributor, installer or supplier used on this project.
 - c. Approved by Architect. Architect may be contacted for list of approved AHC Inspectors.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- B. Overhead Stops/Holders: Set adjustable stops for maximum degree of opening before door encounters obstruction. Adjust friction to control door.
- C. Wall and Floor Mounted Stop/Holders: Adjust holding force with spanner head wrench so that door is held securely, yet is easy to pull out of hold open.
- D. Door Closers:
 - 1. Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
 - 2. Adjust latch period so that door does not slam nor injure fingers.
 - 3. Adjust spring power so that door properly latches.
 - 4. Adjust back check to slow door down before hitting stop point so as to prevent damage to closer, arm, door, frame, and fasteners.
- E. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.

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

3.07 DOOR HARDWARE SETS

Hardware Set 01 - Door EB-101

(3) Butt Hinges	BB5006-454	630	BOM
(1) Panic Device, Rim, 03	40xW03CN-CD	628	DTX
(1) Rim Cylinder	SFIC-6P	626	YAL
(1) Mortise Cylinder	SFIC-6P	626	YAL
(1) Closer, w/Spring Stop	CPS7500	689	NOR
(1) Overhead Rain Drip	16A	628	NGP
(1) Cat H Adhesive Jamb Seal Set	105	DBN	DHS
(1) Panic Threshold	896N x RCE	628	NGP

Hardware Set 02 - Door EB-102

(8) Butt Hinge	BB5006-450	630	BOM
(1) Panic Device, SVR, 03	40xW03CN-CD	628	DTX
(1) Rim Cylinder	SFIC-6P	626	YAL
(2) Overhead Holder, HD, Surface	900H	630	GLY
(1) Panic Threshold	896N x RCE	628	NGP
(2) Surface Bolt-Inactive Leaf	580/585	628	RM
(1) Cat H Adhesive Astragal	SA	DBN	DHS

END OF SECTION

SECTION 08730

DOOR WEATHERSTRIPPING

PART 1 GENERAL

1.01 SUMMARY OF WORK

- A. Provide weatherstripping for all doors on this project. Unless noted on the Drawings, weatherstripping shall apply to exterior doors only.
- B. Certain products have been specified because of characteristics which appear to be most suited to the application such as type and thickness of materials, physical configurations, methods of attachment and probability of obtaining satisfactory performance.

1.02 RELATED WORK

- A. For caulking compound and joint sealers, see Division 7.
- B. Doors are specified elsewhere in Division 8.

1.03 QUALITY ASSURANCE

- A. Manufacturer of Stripping and Seals: To greatest extent possible (where available), provide stripping and seals produced by only one manufacturer.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's standard details, specifications and installation instructions for each type of product required, in accordance with Section 00700 (00710). Furnish templates to other fabricators when required for proper preparation of work to receive stripping and seals.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:
 - 1. National Guard Products, Inc. (NGP)
 - 2. Pemko Manufacturing Co.
 - 3. Reese Enterprises, Inc.

2.02 WEATHERSTRIPPING AT JAMBS AND HEADS (WrStp)

A. Doors

1. Head and Jambs

- a. Seal heads and jambs with compression weatherstrip attached to stop, NGP No. 110NSA, 3/4-inch by 3/16-inch, anodized natural aluminum and neoprene material.
- b. FRP/Aluminum doors shall have aluminum weather-bar stabilizer by door manufacturer.

2. Sill

- a. Seal sill on exterior side of outswing door with Rain Drip and Vinyl Sweep unit NGP No. 101AV, aluminum and vinyl material.
- b. Seal sill on interior side of inswing door with Sweep NGP No. 600, aluminum and nylon, and exterior side of door with Rain Drip NGP No. 17D, aluminum.

B. Frames

1. Head and Jambs

- a. Attach to the door frame at the head and jambs, weatherstripping NGP 132NS closed cell sponge neoprene flexible to -35 degrees Fahrenheit in aluminum clasp.
- b. Supplemental weatherstripping in the space between door and frame may be required to effect proper seal without binding as directed by the ENGINEER.
- c. Supplemental weatherstripping shall be press-on closed cell sponge neoprene flexible to -35 degrees Fahrenheit, rectangular in cross-section and in size of 3/8-inch by 3/16-inch and 1/2-inch by 1/4-inch, as required for the installation. Where required, weatherstripping shall be installed at the intersections of the door frame jambs and stops with the long dimension applied to the stop at the lock and head jambs and applied to the jamb at the hinge side, NGP 361 and 362.

C. Pairs of Doors

1. Aluminum T-Type astragals for FRP/aluminum doors shall be factory installed on the doors to close the space between pairs of doors.
2. Steel Z-Type astragals for hollow metal doors shall be factory installed on doors to close the space between pairs of doors.

D. Threshold

1. Thermal Barrier Threshold, NGP 8424, aluminum and PVC vinyl frost barrier, 4 inches wide and 1/2 inch high.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations, to extent installation requirements are not otherwise indicated.
 1. Provide stainless steel fasteners of type which will not work loose as a result of normal door use, and which are compatible with metal of stripping and door (if metal). Provide only smooth exposed fastener heads which do not constitute a snagging hazard to clothing of building occupants.
 2. Set units plumb and level, accurately centered at optimum location for maintaining a permanent seal.
 3. Adjust doors, frames and hardware, if necessary, to achieve proper operation of seals and stripping.
- B. When required to fill out 1-9/16 inch rabbit for thinner combination doors or effect proper seal in exterior doors, press-on type sponge weatherstripping shall be used as directed by the ENGINEER.
- C. Continuity of Stripping: Except as otherwise indicated, provide continuous stripping at each opening, without unnecessary interruptions at door corners and hardware. Where possible, provide units which will not become ineffective as seals because of misalignment at corners, minor out-of-adjustments on doors and frames, temperature variations and normal wear and aging of materials.

END OF SECTION

SECTION 09265

GYPSUM BOARD ASSEMBLIES ON WOOD FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Description of Work: Work of this Section includes, but is not limited to, the following:

1. Gypsum board and accessories.
2. Veneer plaster.
3. Sound-rated construction and accessories.
4. Gypsum board finishing.
5. Trim and accessories.

B. Related Work Specified Elsewhere

1. See Division 6 for wood framing and furring components.
2. See Section 09900 PAINTING AND FINISHING for gypsum board prime and finish coats.

1.02 SUBMITTALS

A. Product Data

1. Submit manufacturer's specifications and installation instructions with Project conditions and materials clearly identified or detailed for each required system.

1.03 SYSTEM REQUIREMENTS

A. Fire Resistance Ratings

1. Where fire resistance classifications are indicated, provide materials and application procedures identical to those listed by UL or tested according to ASTM E119 for type of construction shown.

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1.04 QUALITY ASSURANCE

- A. Install gypsum board in accordance with applicable requirements and recommendations of Gypsum Association GA 216, "Recommended Specifications for the Application and Finishing of Gypsum Board", except for more stringent requirements of manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Deliver material to site promptly without undue exposure to weather.
2. Deliver in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.

B. Storage

1. Store above ground in dry, ventilated space.
2. Protect materials from soiling, rusting and damage.
3. Store board to be directly applied to masonry walls at 70 degrees Fahrenheit for 24 hours prior to installation.

1.06 PROJECT CONDITIONS

A. Environmental Requirements

1. Do not install gypsum board when ambient temperature is below 40 degrees Fahrenheit.
2. For adhesive attachment of gypsum board, and for finishing of gypsum board, maintain ambient temperature above 50 degrees Fahrenheit from one week prior to attachment or joint treatment until joint treatment is complete and dry.

PART 2 PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

- A. Gypsum Board and Accessories: Listed products establish standard of quality and are manufactured by United States Gypsum Company (USG), Chicago, IL or equal.

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2.02 BOARD MATERIALS

A. Gypsum Board

1. ASTM C1396/C1386M, Type X fire-resistant type.
2. Edges: Tapered.
3. Thickness: 5/8 inch for standard Type X material, 1/2 inch for Firecode C (Type C) material unless otherwise indicated.
4. Acceptable Products
 - a. Typical partitions and ceilings: Equivalent to Sheetrock Firecode or Firecode "C" Gypsum Panels by USG or equal.
 - b. Where foil-backed gypsum board is indicated: Equivalent to Sheetrock Brand Foil-Back, Firecode or Firecode "C" Gypsum Panels by USG or Sheetrock Brand Regular FoilBack, Firecode or Firecode "C" Gypsum Panels by USG.

2.03 ACCESSORIES

A. Metal Trim for Gypsum Board

1. Conform to profile and dimensions indicated.
2. Material for interior Work: Galvanized steel, 26 gage minimum.
3. Corner beads: Equivalent to Dur-A-Bead No. 103, 104, 800 & 900 by USG or equal as needed.
4. Casing beads (edge beads): to 200A, 200B, P-1, 701-B, 801-A, & 801-B by USG or equal as needed.
5. Control joints as shown on the Drawings.
 - a. Roll-formed zinc with perforated flanges.
 - b. Size: 1-3/4 inch wide, with 1/4 inch wide center channel.
 - c. Provide with removable tape strip over channel.
 - d. Acceptable product: Equivalent to No. 093 by USG.

B. Special Trim and Reveals: Extruded aluminum alloy 6063-T5, profiles as indicated.

C. Adhesives and Joint Treatment Materials

1. Conform to requirements of ASTM C475.
2. Joint Compounds
 - a. Drying-type (ready-mixed): Equivalent to SHEETROCK Taping Joint Compound and Topping Joint Compound, or SHEETROCK All Purpose Joint Compound [or Lightweight All Purpose Joint Compound Ready-Mixed] by USG.
 - b. Setting (chemically-hardening) type: Equivalent to SHEETROCK Setting-Type Joint Compound by USG.
3. Laminating adhesive for multiple layers: Special adhesive or joint compound specifically recommended for laminating gypsum boards.
4. Laminating adhesive for direct application: Special adhesive or joint compound specifically recommended for laminating gypsum boards and for adhering gypsum boards to solid substrates.

D. Gypsum Board Screws

1. Comply with ASTM C1002.
2. For non-rated systems, 1-1/4 inch or 1-3/8 inch nails are acceptable.

E. Miscellaneous Accessories

1. Provide as required for complete installations.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and adjoining construction and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install in accordance with reference standards and manufacturer's instructions [and as required to comply with seismic requirements].
- B. Install framing to comply with ASTM C840 requirements that apply to framing installation.
- C. Install supplementary framing, blocking and bracing at terminations in gypsum board assemblies to support fixtures, equipment, heavy trim, grab bars, toilet accessories, furnishings or similar construction.

3.03 BOARD INSTALLATION

A. Single Layer Gypsum Board on Wood Framing

1. Loosely butt gypsum board joints together and neatly fit.
2. Do not place butt ends against tapered edges.
3. Maximum allowable gap at end joints: 1/8 inch.
4. Stagger joints on opposite sides of partitions.
5. Apply ceiling boards first where gypsum board ceilings and wall occur.
6. Cut openings in gypsum board to fit electrical outlets, plumbing, light fixtures and piping snugly and small enough to be covered by plates and escutcheons. Cut both face and back paper.
7. Screw or nail board in place securely with fasteners spaced according to manufacturer's recommendations.

B. Double Layer Gypsum Board on Wood Framing

1. Fasten base layer to studs or furring and attach face layer using laminating adhesive and screws or nails, applied according to manufacturer's instructions.
2. Offset face-layer joints at least 10 inches from parallel base-layer joints.

3.04 ACCESSORY INSTALLATION

A. Trim

1. Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
2. Install metal corner beads at external corners.
3. Install metal casing bead trim whenever edge of gypsum board would otherwise be exposed or semi-exposed.

B. Control Joints

1. Install control joints at junction of gypsum board partitions with walls or partitions of other finish material.
2. Install control joints within long runs of partitions, ceilings or soffits at approximately 30'-0" on center or as indicated.
3. Where gypsum board is vertically continuous, as at stairwells, provide horizontal control joints at each floor level.

C. Special Trim

1. Install as indicated on Drawings and in accordance with manufacturer's instructions.

3.05 FINISHING

A. Provide levels of gypsum board finish for locations as follows, in accordance with Gypsum Association GA 214, "Recommended Specification: Levels of Gypsum Board Finish".

1. Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.

B. Interior Gypsum Board

1. Prefill

- a. Use setting-type joint compound. Mix joint compound according to manufacturer's directions.
- b. Fill joints between boards flush to top of eased or beveled edge.
- c. Fill joints of gypsum board above suspended ceilings in fire-rated partitions.
- d. Wipe off excess compound and allow compound to harden.

2. Taping (Level 1)

- a. Butter taping compound into inside corners and joints.
- b. Center tape over joints and press down into fresh compound.
- c. Remove excess compound.
- d. Tape joints of gypsum board above suspended ceilings.

3. First Coat (Level 2)

- a. Use taping or all-purpose drying-type compound.
- b. Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's instructions.
- c. Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.

4. Second Coat (Level 3)

- a. After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 2 inches beyond edge of first coat.

5. Third Coat (Level 4)

- a. After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 2 inches beyond edge of second coat.
- b. Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.

6. Skim Coat (Level 5)

- a. Apply skim coat of topping or all-purpose drying-type compound over exposed surfaces of gypsum board according to manufacturer's directions.
- b. After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.

C. Joint Compound

- 1. Fill and sand filled joints, edges, corners and openings to produce surface ready to receive veneer finish.
- 2. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.
- 3. Allow joint compound to completely set before applying veneer plaster finish.

D. Trim

- 1. Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
- 2. Install metal corner beads at external corners.
- 3. Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi-exposed, and where gypsum base terminates against dissimilar material.

E. Control Joints

- 1. Install where indicated and specified.

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F. Special Trim and Reveal Joints

1. Install as indicated on Drawings and in accordance with manufacturer's instructions.

3.10 ADJUSTING

- A. Correct damage and defects which may telegraph through finish work.
- B. Leave work smooth and uniform.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Scope

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide painting as shown and specified.
2. The extent of painting Work is shown on the Drawings and Schedules, and as herein specified.
3. The Work includes the painting and finishing of all new and existing interior and exterior exposed items and surfaces throughout the Project included in this Contract, except as otherwise indicated.
4. Surface preparation, priming and coats of paint specified herein are in addition to shop priming and surface treatment specified under other sections of the Work.
5. The term "paint" as used herein means all protective coating systems materials, which includes pretreatments, primers, emulsions, enamels, stains, sealers, fillers and thinners, and other applied materials whether used as primer, intermediate, or finish coats.
6. Paint all exposed surfaces whether or not colors are designated in schedules, except where the natural finish of the material is specifically noted as a surface not to be painted. The term "exposed" as used herein means all items not covered with concrete or finish materials. Ducts, conduits and other materials with corrosion resistant surfaces which are in chases, above finished ceilings, or other inaccessible areas shall not require field painting. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. Where color or finish is not designated, the ENGINEER will select these from standard or special colors or finishes available from manufacturer for the materials system specified.
7. Prepare existing substrates as specified to receive the Work of this Section.
8. Structural and miscellaneous metals covered with concrete shall only receive a primer compatible with the covering material.
9. Pipe markers shall be as specified.

B. Coordination

1. Review installation and restoration procedures under other Sections and coordinate the installation and restoration of items that must be field painted this Section.
2. Notify other contractors in advance of the field painting to provide the other contractors with sufficient time for installation, demolition and restoration of items included in their contracts that must be field painted in this Section.
3. Coordinate the painting of areas that are inaccessible once equipment has been installed.
4. Provide finish coats which are compatible with and made by the same manufacturer as the prime paints used. Review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. CONTRACTOR shall be responsible for the compatibility of all protective coating systems in this Contract. The CONTRACTOR shall be responsible for obtaining and providing information on the characteristics of the finish materials proposed for use, to ensure that compatible prime coats are used. No barrier coats will be used. Notify the ENGINEER in writing of anticipated problems using the coating systems as specified with substrates primed by others.

C. Related Work Specified Elsewhere

1. Division 11, Equipment
2. Division 15, HVAC
3. Division 16, Electrical

D. Painting Not Included: The following categories of Work are not included as part of the field-applied finish Work, but are included in other Sections of these Specifications or in other contracts.

1. Priming: Unless otherwise specified, shop-priming of structural metal, miscellaneous metal fabrications, other metal items and such fabricated components as shop-fabricated or factory-built heating and ventilating, instrumentation and electrical equipment or accessories shall conform to applicable requirements of Section 09900 but is included under the appropriate Sections of this Specification.
2. Pre-Finished Items: Unless otherwise shown or specified, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to), baked-on enamel, porcelain, polyvinylfluoride or other similar finish, finished mechanical and electrical equipment such as light fixtures and distribution cabinets, elevator frames, doors and equipment. CONTRACTOR shall be required to touch

up factory finished items with paint supplied by the item manufacturer. CONTRACTOR shall field paint damaged prefinished items as directed by the ENGINEER.

3. Concealed Surfaces
 - a. Unless otherwise indicated, painting is not required on nonmetallic wall or ceiling surfaces in areas concealed from view and generally inaccessible areas such as furred areas, foundation spaces, utility tunnels, pipe spaces, duct shafts, and elevator shafts, as applicable to this project.
 - b. Paint all piping, equipment, and other items within these areas that do not have a galvanized or other corrosion resistant finish as specified.
4. Cast-in-place concrete, unless specifically scheduled on the Room Finish Schedule or in other Section.
5. Metal surfaces of anodized aluminum, stainless steel, chromium plate, bronze, copper, and similar finished materials will not require finish painting.
6. Operating Parts and Labels
 - a. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts do not require finish painting, unless otherwise specified.
 - b. Do not paint over any code-required labels, such as UL and Factory Mutual, or any equipment identification performance ratings, or nomenclature plates.
 - c. Remove all paint, coating or splatter inadvertently placed on these surfaces.
7. All concrete inside of liquid holding basins unless otherwise specified or noted on Drawings to be painted.
8. All aluminum except electrical conduits specified to be painted and except surfaces in contact with concrete, wood, masonry, dissimilar metals, or in the ground.
9. Copper, aluminum, and stainless steel flashing.
10. Stair treads and risers unless otherwise specified or noted on the Drawings to be painted.

1.02 QUALITY ASSURANCE

A. Manufacturer: Provide products manufactured by the following:

1. Rustoleum Corporation
2. Tnemec
3. Carboline
4. Sherwin-Williams
5. ProSoCo, Inc.

NOTE: Painting systems are listed for 4 manufacturers. Systems of other manufacturers listed above may be allowed providing they are the premium generic coatings available. See Article 2.02, Substitutions. All coatings for potable water contact shall be NSF61 and Kentucky Division of Water approved.

B. Applicator Qualifications

1. Submit the names and experience records of the painting applicator and the painting applicator's superintendent and field foreman. Include a list of utility or industrial installations painted, responsible officials, architects, or engineers concerned with the Project and the approximate contract price.
2. Painting applicators whose submissions indicate that they have not had the experience required to perform the Work will not be approved.

C. Single Source Responsibility: Obtain all materials from the same manufacturer unless otherwise approved. Obtain materials only from manufacturers who will:

1. Provide the services of a qualified manufacturer's representative at the Project site at the commencement of Work and on a weekly basis during painting Work to advise on materials, installation and finishing techniques.
2. Certify long term compatibility of all coatings with all substrates, both new and existing.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:

1. ANSI/ASME A13.1, Scheme for the Identification of Piping Systems
2. Great Lakes - Upper Mississippi River Board of State Sanitary Engineers (Ten States Standards), Recommended Standards for Waste Treatment Works - Latest Edition, Recommended Color Scheme for Piping

3. Great Lakes - Upper Mississippi River Board of State Sanitary Engineers (Ten States Standards), Recommended Standards for Water Works - Latest Edition, Addendum No. 6, Painting of Water Works Piping for Public Water Supplies.
4. 29 CFR OSHA 1910.144, Safety Color Code for Marking Physical Hazards
5. SSPC Volumes 1 and 2, Latest Edition, Good Painting Practices, Systems and Specifications.

1.03 SUBMITTALS

A. Samples: Submit for approval the following:

1. Paint samples for ENGINEER'S review of color and texture only. Compliance with all other requirements is the exclusive responsibility of the CONTRACTOR. Provide a listing of the material and application for each coat of each finish sample.

B. Shop Drawings: Submit for approval the following:

1. Copies of manufacturer's technical information, including paint label analysis, detailed surface preparation guides and application instructions for each material proposed for use.
2. Painting schedule for all areas to be coated.
3. Copies of CONTRACTOR'S proposed protection procedures in each area of the Work.
4. List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.
5. Copies of manufacturer's complete color charts for each coating system.
6. Pipe Markers: Copies of manufacturer's technical brochure, including color chart and list of standard markers.
7. Maintenance Manual: Upon completion of the Work, furnish copies of a detailed maintenance manual including the following information:
 - a. Product name and number.
 - b. Name, address and telephone number of manufacturer, manufacturer's representative, regional office and representative, and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning for each system.

- d. Detailed procedures for light repairs such as dents, scratches and staining.

C. Certificates: Submit for approval the following:

1. Certificates stating that materials meet or exceed Specification requirements.
2. Certificate stating that all coatings are compatible with substrate specified, and factory or field applied prime coats.

D. Test Reports: Submit for approval certified laboratory test reports for required performance tests and minimum solids content of products used.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Material: Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Name or title of material.
2. Manufacturer's batch number and date of manufacture.
3. Manufacturer's name.
4. Contents by volume, for major pigment and vehicle constituents.
5. Thinning instructions where recommended.
6. Application instructions.
7. Color name and number.

B. Storage of Materials

1. Store only acceptable project materials on project site.
2. Store in a suitable location approved by the ENGINEER. Keep storage area clean and accessible.
3. Store in an area where the minimum temperature is 50 degrees Fahrenheit.
4. Restrict storage to paint materials and related equipment.
5. Comply with health and fire hazards regulations including the Occupational Safety and Health Act.

1.05 JOB CONDITIONS

A. Existing Conditions

1. Before painting is started in any area, it shall be thoroughly cleaned by vacuuming with commercial vacuum cleaning equipment or flushing with clean water.
2. After painting operations begin in a given area, cleaning shall then be done only with commercial vacuum cleaning equipment.

B. Environmental Requirements

1. Apply water-base or epoxy paints only when temperature of surfaces to be painted and surrounding air temperatures are between 55 degrees Fahrenheit and 90 degrees Fahrenheit unless otherwise permitted by the paint manufacturer's printed instructions.
2. Apply other paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 65 degrees Fahrenheit and 95 degrees Fahrenheit, unless otherwise permitted by the paint manufacturer's printed instructions.
3. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or when the surface temperature is less than 5 degrees Fahrenheit above dew point; or to damp or wet surfaces.
4. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
5. Adequate illumination and ventilation shall be provided by the CONTRACTOR in all areas where painting operations are in progress. Adequate ventilation and temperature shall be maintained during the required drying time.
6. Install piping markers only after all painting and finish Work has been completed and cured.

C. Protection

1. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.
2. During the painting Work, the treatment plant shall remain in operation. Employ procedures to prevent contamination of the water or wastewater process, or cause plant shutdown due to the Work of this Section. Submit proposals for protection Work to the ENGINEER.
3. Painting shall not begin in any area until ENGINEER approves protection technique proposed by the CONTRACTOR.

PART 2 PRODUCTS

2.01 MATERIAL QUALITY

- A. Provide the best grade of the various types of coatings suitable for use in wastewater and water treatment plants as regularly manufactured by listed acceptable paint materials manufacturers. Materials not displaying the

manufacturer's identification as a standard, premium best-grade product will not be acceptable.

- B. Provide primers produced by the same manufacturer as the finish coats. Thinning shall be avoided if possible. Where thinning is necessary to ensure an acceptable finish, use only thinners recommended and manufactured, and use only to recommended limits.
- C. Provide paints, and pipe markers of durable and washable quality. Use materials which will withstand normal washing as required to remove grease, oil, chemicals, etc., without showing discoloration, loss of gloss, staining, or other damage.

2.02 SUBSTITUTIONS

- A. No substitutions shall be considered that decrease the film thickness, the number of coats, the surface preparation or the generic type of coating specified. Approved manufacturers must furnish the same color selection as the manufacturers specified, including accent colors in all coating systems.
- B. A substitute paint system other than as specified in Part 2 of this section may be used if:
 - 1. The CONTRACTOR satisfactorily proves and documents that they are equivalent to the specified items in (1) quality and (2) durability, (3) suitability for the intended services, (4) resistance to abrasion and physical damage, (5) efficiency in protecting the substrate from corrosion for extended periods, (6) life expectancy, (7) recoating cycles, (8) solids content by volume, (9) dry film thickness per coat, (10) mil square feet per gallon, (11) compatibility with other coatings, (12) resistance to chemical attack, (13) submersion limitations, (14) temperature limitations in service and during application, (15) recommended surface preparation for maximum coating life, (16) type and quality of recommended undercoats and topcoats, (17) generic type, and (18) other pertinent criteria.
 - 2. The CONTRACTOR shall submit to the ENGINEER notarized certificates on the letterhead of the firm manufacturing the proposed substitution certifying (1) that the proposed substitution is the equivalent of the specified material in the qualities specified above, (2) that the list of compared equivalency qualities attached, as required below, is accurate, and (3) that the proposed substitution is suitable for the intended use. The CONTRACTOR shall also submit to the ENGINEER on the letterhead of the firm manufacturing the proposed substitution a list of at least 10 installations similar to the installation for which the products are being proposed, at which installations the proposed products have performed reliably in similar service for at least 5 years; this list shall include the name, address, and telephone number of the owner of each installation, and the name of that owner's employee who is responsible for maintenance and construction.

3. If the proposed coatings have not been used at the number of installations and for the number of years specified above, the CONTRACTOR shall submit to the ENGINEER on the letterhead of the firm manufacturing the proposed substitution, a statement that the manufacturer will guarantee to furnish a bond from an acceptable surety guaranteeing that the manufacturer of the proposed substitution shall, in case of failure by the proposed substitution within a five year period, promptly pay all costs for material and labor for (1) removal of unsuitable coatings, (2) proper reparation of the substrate, (3) recoating with all the coats of the originally specified products in the complete specified coating system in place on the equipment whether the coatings were applied in the shop or in the field, (4) OWNER'S administration and supervision for the corrective action, and (5) bypass and alternate treatment processes while the equipment is unoperative due to coating failure and replacement.
4. If the proposed substitution requires alteration to the contract work, the CONTRACTOR shall bear all such costs involved and the costs of allied trades affected by the substitution.
5. The CONTRACTOR shall submit to the ENGINEER, the paint manufacturer's current printed information and recommendations and product data sheets both for the proposed substitutions and specified products, and shall submit a list comparing the difference between the proposed substitution and the specified products for the equivalency qualities specified hereinbefore and between the 2 paint manufacturer's printed information, recommendations, and product data sheets.
6. No proposed substitution shall be incorporated in the work until all the above submission requirements have been reviewed and accepted by the ENGINEER.

2.03 COLORS AND FINISHES

- A. Surface treatments and finishes, are shown under "Painting Systems" below. All substrates scheduled under "Painting Systems," both new and existing, shall be painted whether or not shown on the Drawings, or in Schedules, unless an item is specifically scheduled as not requiring the painting system scheduled below.
- B. Color Selection: The OWNER may select colors from the standard or custom colors available, in addition to color coding on all piping and ducts.
- C. Color Coding: In general, and unless otherwise specified, all color coding of piping, ducts, and equipment shall comply with applicable standards of ANSI A13.1 and OSHA 1910.144.
- D. Pipe Labeling and Color Code: Refer to Schedule A at end of Section.
- E. Signs: See Schedule B at the end of Section.

- F. Use representative colors when preparing samples for ENGINEER'S review.
- G. Color Pigments: Pure, nonfading, leadfree applicable types to suit substrates and service indicated.

2.04 PAINTING OR COATING SYSTEMS

SYSTEM DESIGNATION: A, B, C, D, etc.

A. **Cast-in-Place Concrete** (except floors and walks) with "Smooth Form and Grout Cleaned Finish and Precast Concrete"; Interior Non-submerged

1. Surface Preparation: Prepare surfaces as specified in 3.02.B.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 9100 Hi-Performance Epoxy - 1 coat, thin first coat 25 percent by volume with 160 thinner, 200 to 250 square feet per gallon.
 - (2) Finish: Series 9100 Hi-Performance Epoxy - 1 coat, 6.0 to 8.0 dry mils per coat, 200 to 400 square feet per gallon per coat.
 - b. Tnemec (System Series 135 Epoxy-polyamidamine)
 - (1) Finish: No. 140 - 2 coats, 4.0 to 6.0 dry mils per coat.
 - c. Carboline
 - (1) Primer: Carboline Carboguard 60.
 - (2) Intermediate: Carboline Carboguard 893 SG at 4.0 to 6.0 dft.
 - (3) Finish: Carboline Carboguard 893 SG at 4.0 to 6.0 dft.
 - d. Sherwin-Williams
 - (1) Primer: Macropoxy 646 - 1 coat at 4.0 to 6.0 dry mils.
 - (2) Finish: Macropoxy 646 - 1 coat at 4.0 to 6.0 dry mils.

B. Cast-In-Place Concrete in Containment Areas with "Smooth Form and Grout Cleaned Finish"

1. Surface Preparation

- a. SSPC-SP 13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3.

2. Product and Manufacturer

a. Rustoleum

- (1) Primer: One coat OverKrete E100 at 8.0 to 10.0 dry mils.
- (2) Finish: One coat OverKrete E100 at 8.0 to 10.0 dry mils.

b. Tnemec

- (1) Primer: 201 Epoxoprime at 180 to 200 s.f./gallon.
- (2) Intermediate Coat: 275 Stranlok at 25.0 dry mils.
- (3)* Finish: 282 Tnemeglaze at 8.0 to 10.0 dry mils.

*For containment of hydrofluosilic acid, the finish (topcoat) coat shall be Tnemec 120-5002 at 15.0 to 18.0 dry mils.

c. Carboline

- (1) Carboline Semstone 870 AFRC (Aggregate Filled Reinforced Coating).

d. Sherwin-Williams

- (1) Primer: Coro-Bond 100 Primer, B58W5100 Series.
- (2) Intermediate Coat: Coro-Bond EN7000, B67A30 Series @ 6.0 to 8.0 mils dft.
- (3) *Finish: Coro-Bond EN 7000, B67A30 Series @ 6.0 to 8.0 mils dft.

*For containment of hydrofluosilic acid, the finish (topcoat) shall be Sherwin-Williams Cor-Cote VENGF System.

e. C.I.M. Industries Inc. (Hydrofluosilic Acid Containment)

- (1) Primer: CIM 61BG – 1 coat, 5.0 dry mils.
- (2) Finish Coat: CIM 2000 – 3 coats, 20 dry mils per coat.

C. Concrete Block Walls and Cast-in-Place Concrete not Conforming to "Smooth Form and Grout Cleaned Finish"; Interior Non-submerged:

1. Surface Preparation: Prepare surfaces as specified in Section 3.02.B. Fill pores of concrete block with block filler at a rate of 50 to 100 square feet per gallon.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 5199 Surface-Sele - 1 coat, 50 to 200 square feet per gallon.
 - (2) Finish: Series 9100 Hi-Performance - 2 coats, 6.0 to 8.0 wet mils per coat, 150 to 250 square feet per gallon per coat.
 - b. Tnemec (System No. 66-15 Epoxy-Polyamide)
 - (1) Primer: No. 130 Modified Acrylic masonry filler - 1 coat at a rate of 75 to 100 square feet per gallon.
 - (2) Intermediate: Series 66 Hi Build Epoxoline - 1 coat, 2.0 to 3.0 dry mils.
 - (3) Finish: Series 66 Epoxoline - 1 coat, 4.0 to 6.0 dry mils.
 - c. Carboline
 - (1) Primer: Carboline Sanitile 100 at approximately 12.0 dft.
 - (2) Intermediate: Carboline Carboguard 60 at 4.0 to 6.0 dft.
 - (3) Finish: Carboline Carboguard 60 at 2.0 to 3.0 dft.
 - d. Sherwin-Williams
 - (1) Primer: Heavy Duty Block Filler, B42W46 - 1 coat at 50 to 90 S.F. per gallon.
 - (2) Finish: Macropoxy 646 - 1 coat at 4.0 to 6.0 dry mils.

D. Concrete Block Walls and Cast-in-Place Concrete; Exterior Non-submerged Opaque:

1. Surface Preparation: Prepare surfaces as specified in Section 3.02.B. Fill pores of concrete block with Block Filler, or equal at a rate of 50 to 100 square feet per gallon, or Tnemec Series 54-562 at a rate of 50 to 100 square feet per gallon.

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2. Product and manufacturer, provide the following:

a. Rustoleum

- (1) Primer: Series 5199 Surface-Sele - 50 to 200 square feet per gallon
- (2) Finish: Series 5200 Hi-Performance Acrylic Coating - 1 coat, 2.0 to 3.0 dry mils per coat.

b. Tnemec

- (1) Blockfiller: Series 130, if required.
- (2) Series 156 Enviro-Crete - 2 coats, 4.0 to 8.0 dry mils each.

c. Carboline

- (1) Primer: Carboline Sanitile 100 at approximately 12.0 dft.
- (2) Finish: Carboline Flexxide Elastomer- 2 coats at 4.0 to 8.0 dft each.

d. Sherwin-Williams

- (1) Primer: Block Filler - 1 coat at 50 to 90 S.F. per gallon
- (2) Finish: Loxon XP - 1 coat at 2.0 to 3.0 dry mils.

E. Architectural, Precast, Poured-in-Place Concrete; Brick Walls, Natural Stone Exterior Sealer, Clear; Non-submerged:

1. Surface Preparation: Prepare surfaces as specified in Section 3.02.B.

2. Product and Manufacturer:

a. ProSoCo, Inc.

- (1) Primer/Finish: Weather-Seal Siloxane, coverage rate may vary:

Brick: 100 to 150 S.F./gallon

Architectural Concrete: 125 to 175 S.F./gallon

Natural Stone: 125 to 175 S.F./gallon

Concrete Masonry Units: 75 to 175 s.f./gallon

b. Sherwin-Williams Company

- (1) Primer/Finish: H&C HB 150

c. Tnemec

- (1) Primer/Finish: Dur A Pell 100 Series 665.

F. Concrete Floors and Walks; Interior

1. Surface Preparation: Prepare surfaces and acid etch as specified in 3.02.B, or in accordance with manufacturer's instructions and approval of the ENGINEER.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: 9100 Epoxy thinned 25 percent with 160 solvent, 200 to 300 square feet per gallon.
 - (2) Finish: 9100 Epoxy Floor Coating - 1 coat, 6.0 to 8.0 dry mils per coat.
 - (3) For anti-skid surface: Broadcast 200 Sliptex after first coat.
 - b. Tnemec
 - (1) Primer: Series 66 Hi Build Epoxoline - 1 coat, 3.0 to 3.0 dry mils.
 - (2) Finish: Series 66 Epoxoline - 1 coat, 4.0 to 6.0 dry mils. Add silica sand to finish coat.
 - c. Carboline
 - (1) Primer: Carboline 60 Epoxy, 1 coat, thinned 15 percent #2 thinner, 2.0 to 3.0 mils DFT.
 - (2) Finish: Carboline 60 Epoxy, 1 coat 4.0 to 6.0 dry mils for non-skid, add 1/4 to 1/2 gallon of silica sand to each gallon.
 - d. Sherwin-Williams
 - (1) Primer: Armor Seal 1000HS, B67W2000 Series - 1 coat at 2.0 to 3.0 mils DFT.
 - (2) Finish: Armor Seal 1000HS, B67W2000 Series - 1 coat at 3.0 to 5.0 mils DFT.

G. Submerged Concrete; Interior and Exterior, Potable Water (NSF 61 Certified)

1. Surface Preparation
 - a. SSPC-SP13/NACE 6 to achieve a surface profile of ICRI CSP 2 or 3.
2. Product and Manufacturer
 - a. Rustoleum
 - (1) Primer and Finish: Two coats 9200 (NSF) Epoxy with first coat thinned 25 percent with solvent recommended by manufacturer at 10.0 to 12.0 total dry mils.
 - b. Tnemec
 - (1) Primer: Series 20-1255 at 3.0 to 5.0 dry mils.
 - (2) Finish: Series 20-15BL at 4.0 to 6.0 dry mils.
 - c. Carboline
 - (1) Primer: Carboline Carboguard 61 at 4.0 to 6.0 DFT.
 - (2) Finish: Carboline Carboguard 61 at 4.0 to 6.0 DFT.
 - d. Sherwin-Williams
 - (1) Primer: Macropoxy 646 PW – 1 coat at 5.0 to 6.0 dry mils.
 - (2) Finish: Macropoxy 646 PW – 1 coat at 5.0 to 6.0 dry mils.

NOTE: Fill concrete as necessary with Kem Cati-Coat Epoxy Filler/Sealer, B42WA8/B42WA9.

H. Submerged Concrete; Interior and Exterior, Wastewater Exposure

1. Surface Preparation: As specified in Section 3.02.B. and vacuum with commercial cleaning equipment or flush with clear water to eliminate dust.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 9200 Epoxy - Thin 15 to 20 percent with 165 solvent, first coat only.
 - (2) Finish: No. 9200 High Build Epoxy - 1 coat, 5.0 to 8.0 dry mils, 100 to 150 square feet per gallon.

- b. Tnemec
 - (1) Primer: N 140 - 1 coat, 4.0 to 6.0 dry mils.
 - (2) Finish: N 140 - 1 coat, 4.0 to 6.0 dry mils.
- c. Carboline
 - (1) Primer: Carboline Carboguard 890 at 4.0 to 6.0 DFT.
 - (2) Finish: Carboline Carboguard 890 at 4.0 to 6.0 DFT.
- d. Sherwin-Williams
 - (1) Primer: Dura-Plate 235, B67 Series, at 4.0 to 8.0 DFT.
 - (2) Finish: Dura-Plate 235, B67 Series, at 4.0 to 8.0 DFT.

I. Ferrous Metals and all Ferrous Piping; Interior Non-submerged

- 1. Product and Manufacturer: Provide one of the following:
 - a. Rustoleum
 - (1) Surface Preparation: SSPC-SP6 Commercial Blast Cleaning.
 - (2) Shop Primer: No.9380 Epoxy Primer - 1 coat, 3.0 to 5.0 dry mils per coat, 9360
 - (3) Intermediate and Field Touch-up: Series HS9381 Epoxy, Primer 1 coat 3.0 to 5.0 dry mils
 - (4) Finish: Series 9100 High Performance Epoxy - 1 coat, 5.0 to 9.0 dry mils per coat.
 - b. Tnemec
 - (1) Surface Preparation: SSPC-SP6 Commercial Blast Cleaning
 - (2) Primer: Series 66 Hi Build Epoxoline - 1 coat, 4.0 to 6.0 dry mils.
 - (3) Finish: Series 66 Epoxoline - 1 coat, 4.0 to 6.0 dry mils.
 - c. Carboline
 - (1) Primer: Carboline Carboguard 60 at 2.0 to 3.0 DFT.

(2) Intermediate: Carboline Carboguard 893 SG at 4.0 to 6.0 DFT.

(3) Finish: Carboline Carboguard 893 SG at 4.0 to 6.0 DFT.

d. Sherwin-Williams

(1) Primer: Macropoxy 646 – 1 coat at 3.0 to 5.0 dry mils.

(2) Finish: Macropoxy 646 – 2 coats at 3.0 to 5.0 dry mils.

J. Submerged or Intermittently Submerged Ferrous Metals: Interior and Exterior, Wastewater Exposure

1. Surface Preparation: SSPC-SP10 Near-White Blast Cleaning

2. Product and Manufacturer: Provide the following:

a. Rustoleum

(1) Primer: No. 9271 NSP Primer - 1 coat, 5.0 to 8.0 dry mils.

(2) Finish: Series 9292 NSF - 2 coats, 5.0 to 8.0 dry mils per coat.

b. Tnemec

(1) Primer: N 140 - 1 coat, 4.0 to 6.0 dry mils per coat

(2) Finish: N 140 - 2 coats, 4.0 to 6.0 dry mils per coat

c. Carboline

(1) Primer: Carboline Carboguard 890 at 2.0 to 3.0 DFT.

(2) Intermediate: Carboline Carboguard 890 at 4.0 to 6.0 DFT.

(3) Finish: Carboline Carboguard 890 at 4.0 to 6.0 DFT.

d. Sherwin-Williams

(1) Primer: Dura-Plate 235 – 4 coats at 3.0 to 5.0 dry mils.

(2) Finish: Dura-Plate 235 – 2 coats at 4.0 to 5.0 dry mils.

K. Submerged or Intermittently Submerged, Ferrous and Non-ferrous Metals; Interior and Exterior, Potable Water Exposure

1. Surface Preparation:
 - a. Ferrous Metals- SSPC-SP-10 with 2.0 mil profile.
 - b. SSPC SP 16 Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, and Non-Ferrous Metals.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: 9200 (NSF) Epoxy at 5.0 to 6.0 dry mils.
 - (2) Finish: 9200 (NSF) Epoxy at 5.0 to 6.0 dry mils.
 - b. Tnemec
 - (1) Primer: N 140 at 3.0 to 5.0 dry mils.
 - (2) Finish: N 140 at 4.0 to 6.0 dry mils.
 - c. Carboline
 - (1) Primer: Carboline Carboguard 61 at 4.0 to 6.0 DFT.
 - (2) Finish: Carboline Carboguard 61 at 4.0 to 6.0 DFT.
 - d. Sherwin-Williams
 - (1) Primer: Macropoxy 646 PW – 1 coat at 3.0 to 5.0 dry mils.
 - (2) Finish: Macropoxy 646 PW – 2 coats at 4.0 to 5.0 dry mils.

L. Ferrous, Non-ferrous Metals and Galvanized Metals; Exterior Non-submerged

1. Surface Preparation
 - a. Ferrous Metals: SSPC-SP-10 with 2.0 mil profile.
 - b. SSPC SP 16 Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, and Non-Ferrous Metals.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 9100 H.P. Epoxy - 1 coat, 5.0 to 8.0 dry mils.

- (2) Finish: Series 9400 Polyurethane - 1 coat, 2.0 to 3.0 dry mils per coat.
- b. Tnemec
 - (1) Primer: Series 66 Hi Build Epoxoline - 1 coat, 4.0 to 6.0 dry mils.
 - (2) Finish: Series 1074/1075 - 1 coat, 2.0 to 3.0 dry mils.
- c. Carboline
 - (1) Primer: Carboline Carboguard 60 at 2.0 to 3.0 DFT.
 - (2) Intermediate: Carboline Carboguard 60 at 4.0 to 6.0 DFT.
 - (3) Finish: Carboline Carbothane 134 HG at 2.0 to 3.0 DFT.
- d. Sherwin - Williams
 - (1) Primer: Macropoxy 646 - 2 coats at 3.0 to 4.0 dry mils per coat.
 - (2) Finish: Acrolon 218HS, B65 Series - 1 coat at 3.0 to 4.0 dry mils.

M. Galvanized Metal and Non-Ferrous Metal; Interior, Non-submerged

- 1. Surface Preparation
 - a. Ferrous Metals- SSPC-SP-10 with 2.0 mil profile.
 - b. SSPC SP Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, and Non-Ferrous Metals.
- 2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 9100 Epoxy - 1 coat, 5.0 to 8.0 dry mils.
 - (2) Finish: Series 9100 Epoxy - 1 coat, 5.0 to 8.0 dry mils, 100 to 200 square feet per gallon
 - b. Tnemec
 - (1) Primer: Series 66 Hi Build Epoxoline - 1 coat, 3.0 to 5.0 dry mils.

(2) Finish: Series 66 Epoxoline - 1 coat, 4.0 to 6.0 dry mils.

c. Carboline

(1) Primer: Carboline Galoseal at 2.0 to 4.0 DFT.

(2) Finish: Carboline Carbocrylic 3359 at 2.0 to 3.0 DFT.

d. Sherwin-Williams

(1) Primer: Macropoxy 646 - 1 coat at 4.0 to 6.0 dry mils.

(2) Finish: Macropoxy 646 - 1 coat at 4.0 to 6.0 dry mils.

N. Submerged or Intermittently Submerged Galvanized Ferrous Metal; Interior and Exterior

O. All Metal Surfaces Exposed to Temperatures Over 250 Degrees Fahrenheit

P. Pipe and Duct Installation, Cloth; Interior

1. Surface Preparation: Remove all foreign matter as specified in 3.02 G

2. Products and Manufacturer: Provide the following:

a. Rustoleum

(1) Primer: 5281 Acrylic Primer - 1 coat, 2.0 to 3.0 mils

(2) Finish: Series 5200 Acrylic Gloss - 1 coat, 2.0 to 3.0 mils

b. Tnemec

(1) Primer: Series 6/7 Color Tnemecryl - 1 coat, 2.0 to 3.0 dry mils

(2) Finish: Series 6/7 Color Tnemecryl, 2.0 to 3.0 dry mils

c. Carboline

(1) Primer: Carboline Carbocrylic 3358 at 2.0 to 3.0 DFT.

(2) Finish: Carboline Carbocrylic 3359 at 2.0 to 3.0 DFT.

d. Sherwin-Williams

(1) Primer: DTM Acrylic Coating, B66 Series - 1 coat at 2.5 to 3.0 dry mils.

- (2) Finish: DTM Acrylic Coating, B66 Series - 1 coat at 2.5 to 3.0 dry mils.

Q. PVC Piping, Fiberglass, Fiberglass Insulation Covering; Interior

1. Surface Preparation: Sand as specified in 3.02 G.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 9100 Epoxy - 1 coat, 2.0 to 3.0 dry mils
 - (2) Finish: Series 9100 Epoxy - 1 coat, 5.0 to 8.0 dry mils per coat
 - b. Tnemec
 - (1) Primer: Series 66 Hi Build Epoxoline – 1 coat, 2.0 to 3.0 dry mils.
 - (2) Finish: Series 66 Epoxoline – 1 coat, 2.0 to 3.0 dry mils.
 - c. Carboline
 - (1) Primer: Carboline Carboguard 60 at 2.0 to 3.0 DFT.
 - (2) Finish: Carboline Carboguard 60 at 2.0 to 3.0 DFT.
 - d. Sherwin-Williams
 - (1) Primer: Macropoxy 646 – 1 coat at 2.0 to 3.0 dry mils.
 - (2) Finish: Macropoxy 646 – 1 coat at 2.0 to 3.0 dry mils.

R. Gypsum Wallboard, Interior

1. Surface Preparation: Sand and seal as specified in 3.2.H.
2. Product and Manufacturer: Provide the following:
 - a. Rustoleum
 - (1) Primer: No. 5290 Low Gloss Acrylic - 1 coat, 2.0 to 3.0 dry mils, 225 to 320 square feet per gallon.
 - (2) Finish: No. 5290 Low Gloss Acrylic - 2 coats, 3.5 to 6.0 wet mils, 2.0 to 3.0 dry mils per coat, 225 to 400 square feet per gallon.

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b. Tnemec

- (1) Primer: No. 51-792 PVA sealer - 1 coat, 1.0 to 2.0 dry mils.
- (2) Intermediate: No. 113/114, Color Tneme, Tufcoat - 1 coat, 2.0 to 2.5 dry mils
- (3) Finish: No. 113/114, Color Tneme, Tufcoat - 1 coat, 2.0 to 2.5 dry mils

c. Carboline

- (1) Primer: Carboline Sanitile 120 at 1.0 to 2.0 DFT.
- (2) Intermediate: Carboline Carbocrylic 3359 at 2.0 to 3.0 DFT.
- (3) Finish: Carboline Carbocrylic 3359 at 2.0 to 3.0 DFT.

d. Sherwin-Williams

- (1) Finish: 2 coats Fromar 200 Eggshell at 1.5 to 2.0 DFT per coat.

S. Wood Surfaces; Interior, Clear

1. Surface Preparation: Sand and seal as specified in 3.2.I.
2. Product and Manufacturer: Provide the following:
 - a. Stain as shown on the Drawings or specified with 2 coats of Spar Varnish, or equal
 - b. Finish with either Clear 9410 Polyurethane by Rustoleum - 2 coats, 2.5 to 5.0 wet mils per coat, 275 to 575 square feet per gallon per coat or 134 H.S. Clear by Kop-Coat - 2 coats, 4.0 to 5.0 wet mils per coat.
 - c. Sherwin-Williams
 - (1) Spar Varnish: Exterior varnish or polyurethane varnish.
 - (2) Clear polyurethane, Corothane I Clear, B65 Series.

T. Wood Surfaces; Interior or Exterior, Opaque

1. Surface Preparation: Sand and seal as specified in 3.2.I.

2. Product and Manufacturer: Provide the following:

a. Rustoleum

- (1) Primer: No. 7600 Alkyd Primer - 1 coat, 2.0 to 4.5 wet mils, 320 to 500 square feet per gallon. Thin per manufacturer's instructions for wood surfaces.
- (2) Intermediate: No. 7600 Low VOC Alkyd - 1 coat, 2.5 to 4.5 wet mils, 320 to 500 square feet per gallon
- (3) Finish: Series 7600 Low VOC Alkyd - 1 coat, 2.5 to 4.0 wet mils, 300 to 500 square feet per gallon

b. Tnemec

- (1) Finish: No. 2H Hi-Build Alkyd - 2 coats, 2.0 to 3.0 dry mils per coat.

c. Carboline

- (1) Primer: Carboline Sanitile 120 at 1.0 to 2.0 DFT.
- (2) Finish: Carboline Carbocoat 139 at 2.0 to 3.0 DFT.

d. Sherwin-Williams

- (1) Primer: Industrial Enamel HS - 1 coat at 2.0 to 3.0 dry mils.
- (2) Finish: Industrial Enamel HS - 1 coat at 2.0 to 3.0 dry mils.

U. Ferrous Metals, Buried Exterior or Concrete Waterproofing, Buried Exterior

1. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning (ferrous metals). Clean concrete of all dirt, residues.

2. Product and Manufacturer: Provide the following:

a. Rustoleum

- (1) Finish: No. C9578 Tar Epoxy - 2 coats, 6.0 to 8.0 dry mils per coat, 100 to 150 square feet per gallon per coat.

b. Tnemec (System No. 46-30 Coal Tar Epoxy)

- (1) Finish: No. 46H - 413 Hi-Build Tneme - Tar, 1 coat, 14.0 to 20.0 dry mils

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c. Carboline

(1) Finish: Carboline Bitumastic 300 M at 16.0 to 20.0 DFT.

d. Sherwin-Williams

(1) Finish: HiMil Sher-Tar, B69B40/B69V40 - 1 coat at 16.0 to 20.0 dry mils.

2.05 STENCILING

A. General

1. After all painting of all pipe, valves and appurtenances has been completed, such installations shall be stenciled or otherwise labeled with the name of such installation at intervals not to exceed 10 feet.
2. Pipe lines shall be stenciled or otherwise labeled showing direction of flow at intervals not to exceed 10 feet.
3. The pipe shall be stenciled on each side if the pipe, valves and appurtenances can be viewed from both sides.

PART 3 EXECUTION

3.01 INSPECTION

- A. CONTRACTOR and his applicator shall examine areas and conditions under which painting work is to be performed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 SURFACE PREPARATION

A. General

1. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.
2. Prepare existing substrates required to be painted under this Section as specified for new substrates. Where other methods of preparing existing substrates are proposed by the CONTRACTOR, they shall be submitted to the ENGINEER for approval. ENGINEER's approval of alternate substrate preparation shall not relieve the CONTRACTOR of this required performance under this Section.

3. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection, prior to surface preparation and painting operations. Remove, if necessary, for complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.
4. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and trisodium phosphate and water or cleaning solvents prior to mechanical cleaning. Program cleaning and painting so that dust and other contaminants from cleaning process will not fall onto wet, newly-painted surfaces.
5. All surfaces which were not shop painted or which were improperly shop painted, and all abraded or rusted shop painted surfaces, which are to be painted, as determined by the ENGINEER, shall be prepared as specified below.
6. All submerged metals shall be field prepared and field coated in lieu of shop preparation.

B. Concrete, Precast Concrete, and Masonry Surfaces

1. Surface preparation shall be in accordance with SSPC-SP 13/NACE No. 6. Surface Preparation of Concrete and the following requirements.
2. Prepare surfaces of concrete, precast concrete, and concrete block to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, with soap and water. All cracks, nails, nail holes, and fins shall be removed and/or filled before painting.
 - a. Concrete shall have been allowed a minimum curing time of 30 days prior to painting.
 - b. Any measurable protrusions in concrete block shall be ground smooth prior to painting.
 - c. All spilled concrete or excess concrete from mortar joints shall be ground smooth prior to painting.
3. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Provide the ENGINEER with suitable testing materials in order to carry out alkalinity and moisture tests.
4. Determine, by testing surfaces, that no chlorides are present.

5. Do not paint over surfaces where moisture content exceeds that permitted in the manufacturer's printed directions.
6. Remove loose or incompatible existing finish coats as recommended by the paint manufacturer for full product responsibility. Brush blast or power tool clean all residue and create uniform rough texture.
7. Acid etch submerged concrete and concrete floor surfaces with Rustoleum Surfa-Etch, or equal, or a commercial solution of muriatic acid, 15 percent concentration. Other surfaces that cannot be adequately cleaned by soap and water in the opinion of the ENGINEER shall also be acid etched. Exceedingly dense concrete may require a second etching. Flush floor with clean water to neutralize acid, and allow to dry before painting.

C. Ferrous Metals

1. Clean non-submerged ferrous surfaces including structural steel and miscellaneous metal to be shop primed, of all oil, grease, dirt, mill scale, and other foreign matter by commercial blast cleaning complying with SSPC-SP 6, minimum.
2. Clean submerged ferrous surfaces including structural steel and miscellaneous metal to be primed, of all oil, grease, dirt, chloride, mill scale, and other foreign matter by near-white blasting complying with SSPC-SP 10.
3. Clean non-submerged ferrous surfaces that have not been shop-coated of all oil, grease, dirt, chloride, loose mill scale, and other foreign substances by commercial blasting, complying with SSPC-SP 6, minimum.
4. Clean submerged ferrous surfaces that have not been shop-coated or that, in the opinion of the ENGINEER, have been improperly shop coated, of all oil, grease, dirt, chloride, mill scale, and other foreign matter by near white blasting complying with SSPC-SP 10.
5. Touch up shop-applied prime coats which have been damaged or bare areas, with primer recommended by the coating manufacturer after commercial blasting complying with SSPC-SP 6, or by SSPC-SP-3 power tool cleaning.
6. Remove all rust and contamination on existing ferrous metals to sound substrate with abrasive wheels, SSPC-SP 3.

D. Non-Ferrous Metal Surfaces: Clean non-ferrous metal surfaces in accordance with the coating system manufacturer's instructions for the type of service, metal substrate, and application required.

- E. Galvanized Surfaces: Clean free of oil and surface contaminants with solvent wipe and water cleaning, recommended by the coating manufacturer, complying with SSPC-SP 16.
- F. PVC Piping and Fiberglass: Lightly sand and clean all surfaces to be painted.
- G. Insulation Covering: Clean free of oil and surface contaminants as recommended by the coating manufacturer for substrate and application required. Do not cut or damage the insulation in any way.
- H. Plaster and Gypsum Wallboard
 - 1. Patch, sand, and seal all rough spots before prime coat.
 - 2. Touch up all suction spots and hot spots with primer before application of finish coats.
- I. Wood
 - 1. Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
 - 2. Seal wood required to be job painted immediately upon delivery to job. Seal edges, ends, faces, undersides, and backsides of such wood including chair rails, moldings and trim, cabinets, counters, cases, and paneling.

3.03 MATERIALS PREPARATION

A. General

- 1. Mix and prepare painting materials in strict accordance with manufacturer's directions.
- 2. Do not mix coating materials produced by different manufacturers.
- 3. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.
- 4. Stir all materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

3.04 APPLICATION

A. General

1. Apply paint by brush, roller, air spray, or airless spray in strict accordance with manufacturer's detailed instructions and recommendations of Paint Application Specifications No. 1 in SSPC Vol. 2, where applicable. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required. Use airless spray equipment that is capable of providing 1500-3000 psi at the nozzle.
2. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried/cured.
3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is of uniform finish, color, and appearance. This is of particular importance regarding intense primary accent colors. Ensure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.
4. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint as specified, before final installation of equipment.
5. Finish exterior doors on tops, bottoms, and side edges same as exterior faces, unless otherwise specified.
6. Paint metal or wood parts in contact with dissimilar materials as specified with appropriate primer.
7. Omit field primer on metal surfaces that have been primed with an open approved primer at the point of manufacturer. Touch-up paint prime coats only when approved by ENGINEER.

- B. Minimum Coating Thickness: Apply each material at not less than manufacturer's recommended spreading rate, and provide total dry film thickness as specified. Apply extra coat if required to obtain specified total dry film thickness or to provide a uniform finished appearance.

C. Scheduling Painting

1. Apply the first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practical after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coatings in accordance with manufacturer's instructions to permit proper drying. Do not recoat until

paint has dried to where it feels firm, does not deform or feel sticky under moderate pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to ensure a finish with no burn-through or other defects caused by insufficient sealing.

E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

F. Transparent (Clear) Finishes

1. On exposed-to-view portions, use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
2. Provide satin finish for final coats, unless otherwise indicated.

G. Brush Application

1. Brush-out and work all brush coats onto the surface in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable. Neatly draw all glass and color break lines.
2. Brush apply all primer or first coats, unless otherwise permitted to use mechanical applicators.

H. Mechanical Applicators

1. Use mechanical methods for paint application when permitted by governing ordinances, paint manufacturer, and approved by ENGINEER. If permitted, limit to only those surfaces impractical for brush applications.
2. Limit roller applications, if approved by the ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.
3. Confine spray application to metal framework, siding, decking, wire mesh, and similar surfaces where hand brush work would be inferior and to other surfaces specifically recommended by paint manufacturer.
4. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of 2 coats in one pass.

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- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements as required by the ENGINEER.
- J. Stenciling of Pipe, Valves, and Appurtenances: Stencil all pipe, valves, and appurtenances as specified in 2.05.A. The CONTRACTOR shall provide and install under glass 4 framed color legends to be mounted as instructed by the ENGINEER.

3.05 PROTECTION

- A. Protect work of other trades, whether to be painted or not, from the work of this Section. Leave all such work undamaged. Correct all damages by cleaning, repairing, or replacing, and repainting, as acceptable by the ENGINEER.
- B. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove all temporary protective wrappings provided for protection of this Contract and other contracts after completion of painting operations.

3.06 CLEAN-UP

- A. During progress of work, remove from site all discarded paint materials, rubbish, cans, and rags, at the end of each work day.
- B. Upon completion of painting work, clean all paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces as determined by the ENGINEER.

3.07 SCHEDULE A: PIPE LABELING AND COLOR CODE

Pipe Label	Specified Color	Tnemec Color
Air	Forest Green	Hunter Green - PL20
Sodium Hypochlorite	Federal Safety Yellow	Safety Yellow SC01 w/Black Label "sodium hypochlorite"
Sulfuric Acid	Federal Safety Yellow w/1 Federal Safety Red Band	Federal Safety Yellow SC01 w/1 Federal Safety Red SC09 Band w/Black Label "sulfuric acid"
Drain	Federal Safety Orange	Safety Orange - SC03
Fuel Oil (Diesel)	Federal Safety Red w/1 White Band	Safety Red w/1 White Silence - SC-09 w/AA03
Natural Gas	Federal Safety Red	Safety Red - SC09

Pipe Label	Specified Color	Tnemec Color
Non-Potable Water	Marlin Blue w/3 Red Bands	Safety Blue w/Safety Red – SC06 w/SC09
Membrane Drain/ Membrane to Waste	Light Brown	Jute – YB19
Sludge	Dark Brown	Old Hickory – YB28
Potable Water	Marlin Blue	Safety Blue – SC06
Membrane Effluent	Marlin Blue	Safety Blue – SC06
Polymer	Orange w/Green Band	Safety Yellow w/Safety Green SC02 w/SC07
Citric Acid	Light Green w/Violet Band	Safety Green w/Safety Purple SC07 w/SC08
Sodium Bisulfite	Yellow w/Black Band	Federal Safety Yellow SC01 w/Black Label “sodium bisulfate”
DePac	Orange	Safety Yellow – SC02 w/Black Label “alum” or “PACL”
Carbon Slurry	Black	Black – ANSI #61 – IN05
Fluoride-Hydrofluosilicic Acid	Light Blue w/1 Red Band	Clark Sky w/Safety Red – EN17 w/SC09
Phosphate Comp.-Aqua-Mag	Light Green w/1 Red Band	Safety Green w/Safety Red – SC07 w/SC09
Sodium Permanganate	Violet	Safety Purple – SC08
Sewer (Sanitary & Other)	Dark Grey	Gray – ANSI #61 – IN05
Membrane Backwash - Backpulse	Blue	Safety Blue w/ Label – SC06
Electrical Conduit	Not Specified	Match Room Color or Paint Light Gray – ANSI #70 – IN01
Sodium Hydroxide (Caustic Soda)	Yellow w/Green Band	Safety Yellow w/Safety Green – SC01 w/SC07
Raw Water	Olive Green	Hampton Green – GB54

3.08 SCHEDULE B: SIGNS

- A. The following signs shall be provided with mounting frames and installed as directed by the ENGINEER:

Sign	Size		Quantity	Location
	Horizontal	Vertical		
Danger - High Voltage	10"	14"	4	At each entrance
Confined Space - Entry By Permit Only	10"	14"		Over the sanitary submersible pump station
Fire Extinguisher	20"	4"	2	At & above each extinguisher
Danger - No Smoking	10"	14"		At each entrance to the chemical storage area; in each direction facing the main isle of the chemical storage area
Caution - Hazard Area - Authorized Personnel Only	10"	14"		
Danger - Plant Service Water - Do Not Drink	10"	14"		At each hose station or hose bib
Danger - Ear Protection Required	10"	14"		
Authorized Personnel Only - Explosives Materials May be Present - No Smoking	10"	28"		Carbon Room
Authorized Personnel Only	10"	14"		Lab
Danger - No Open Flames	10"	14"		
CLASS 1 OXIDIZER	20"	4"		
CLASS 2 OXIDIZER	20"	4"		One at each sodium permanganate area
Caution - No Food or Drink in This Area	10"	14"		At each entrance to the chemical storage area
Emergency Shutoff Valve	10"	14"		On each chemical system
Danger - Water Reactive Chemical	10"	14"		In the sulfuric acid storage room and by metering pumps

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Sign	Size		Quantity	Location
	Horizontal	Vertical		
All Visitors Must Check in at the Office	20"	14"		At the main plant entrance gate.

- B. All signs shall be red and black on white and shall meet applicable OSHA Specifications. They shall be heavy duty painted aluminum 1/16-inch thick, rust, weather, and sunlight resistant.

3.09 SCHEDULE C: EXTENT OF PAINTING

<u>New Electrical Building</u>	<u>Color</u>	<u>Coating System</u>
PVC Conduit	Match Malls	Q
Galvanized Steel Conduit	Match Walls	M
Aluminum Conduit	Match Walls	M
Electrical MCC-Touch-up	Mfgr Std	Per Mfgr
Drywall	To be determined	R
Interior Concrete Block	To be determined	C
Misc Equipment Items-Touch-up	Mfgr Std	Per Mfgr
Floor	To be determined	F
HVAC Equipment-Touch-up	Mfgr Std	Per Mfgr
Generator-Touch-up	Mfgr Std	Per Mfgr

END OF SECTION

SECTION 15010

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, equipment and incidentals necessary to provide complete and operational mechanical systems as shown on the Drawings and as specified herein.
- B. Installation of equipment that has not been specifically detailed in the Drawings shall be installed per that equipment manufacturer's recommended installation instructions or industry Standard Methods. All hardware and materials required for said equipment installation shall be included in the bid price.
- C. Demolition shall be as shown on the Drawings and shall be in accordance with the requirements of Division 2. Where HVAC equipment is removed, controls and power (conduit and wiring) shall also be removed and surfaces shall be repaired and painted to match existing. Actual holes in the roof and walls, from the removal of equipment and accessories, shall be repaired and surfaced to match the existing construction.
- D. Reference the "General Mechanical Notes" that are applicable to all HVAC work in the Contract Drawings for additional requirements.

1.02 RELATED WORK

- A. The following work incidental to the mechanical system work shall be done under other Sections of the Specifications.
 - 1. Cutting and patching are included in Divisions 3 and 4.
 - 2. Concrete work, including equipment pads, is included in Division 3.
 - 3. Electric work (except as herein specified) is included in Division 16.
 - 4. Field painting is included in Division 9, Section 09900.
 - 5. Firestopping is addressed in Division 7, Section 07840.

1.03 PROTECTION OF MATERIALS, WORKS AND GROUNDS

- A. Materials, fixtures, and equipment shall be properly protected and all pipe openings shall be temporarily closed so as to prevent obstruction and damage.
- B. Protect and preserve all materials, supplies and equipment of every description and all work performed. Damages shall be repaired or replaced promptly at no additional cost to the OWNER.

1.04 CLEANING

- A. During the progress of the work, clean up and remove all oil, grease and other debris. At completion, clean all equipment, piping and duct systems, remove all stickers, non-permanent tags, and leave all work in perfect operating condition.

1.05 DRAWINGS

- A. All work shown on the Drawings is intended to be approximately correct to scale, but figures dimensions and detailed drawings are to be followed in every case. The Drawings shall be taken in a sense as diagrammatic. Size of pipes and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the Drawings, all necessary parts to make complete working systems ready for use shall be furnished without extra charge. All work shall be installed in such a manner to avoid being unsightly.
- B. Locations shown on the Drawings are approximate, and it is intended that all equipment shall be located in accordance with the general and detail Drawings of the construction proper. All measurements shall be taken at the site.

1.06 REFERENCES

- A. Kentucky Building Code
- B. Kentucky State Plumbing Law, Regulations and Code
- C. Standards for Gas Piping on Customer's Premises, Columbia Gas Distribution Companies
- D. Kentucky Regulation, 803 KAR 2:200, Confined Space Entry
- E. International Mechanical Code
- F. Kentucky Boiler and Pressure Vessel and Pressure Piping Law Rules and Regulations
- G. ASHRAE, American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.
- H. International Fire Code
- I. International Energy Conservation Code

1.07 CODES, ORDINANCES AND PERMITS

- A. The minimum standard for all work shall be the latest revision of the Kentucky Building Code (KBC), and the National Electrical Code (NEC). Whenever and wherever state laws and/or regulations and/or the ARCHITECT/ENGINEER'S design requires a higher standard than the current NEC or KBC, then these laws and/or regulations and/or the design shall be followed.

B. Following is a list of applicable Standards or Codes:

	<u>Organization/Code/Standard</u>	<u>Abbreviated Title</u>
1.	International Mechanical Code	IMC
2.	Kentucky Building Code	KBC
3.	National Electrical Code	NEC
4.	National Electrical Safety Code	NESC
5.	Underwriters Laboratories, Inc.	UL
6.	Factory Mutual System	FM
7.	National Fire Protection Association	NFPA
8.	National Electrical Manufacturers Association	NEMA
9.	Occupational Safety and Health Administration	OSHA
10.	Instrument Society of America	ISA
11.	American National Standards Institute, Inc.	ANSI
12.	Anti-Friction Bearing Manufacturers Association, Inc.	AFBMA
13.	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.	ASHRAE
14.	Kentucky Boiler Law	
15.	Sheet Metal and Air Conditioning Contractors National Association, Inc.	SMACNA
16.	International Fire Code	IFC
17.	International Energy Conservation Code	IECC

C. Obtain all required permits, pay all legal fees for the same, and in general, take complete charge and responsibility for all legal requirements pertaining to this Section of the work.

1.08 FEES

A. CONTRACTOR shall be responsible for all fees for connecting natural gas, water, and sewer to construction project unless otherwise noted.

1.09 LABELING

A. All mechanical equipment and items utilizing electrical components shall be UL listed for the application, where a listing exists.

1.10 COOPERATION WITH OTHER TRADES

A. The work shall be so performed that the progress of the entire building construction including all other trades, shall not be delayed nor interfered with. Materials and apparatus shall be installed promptly when and as desired.

B. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Refer to the General Conditions for Dispute Resolution Requirements. All work and materials placed in violation of this clause shall be readjusted to the ARCHITECT/ENGINEER'S satisfaction at no expense to the OWNER.

- C. Where work of this Section will be installed in close proximity to work of other Sections or where there is evidence that the work of this Section will interfere with work of other Sections, assist in working out space conditions to make satisfactory adjustment. If so directed, prepare and submit for approval 3/8-inch scale or larger working drawings and sections, clearly showing how this work is to be installed in relation to the work of other Sections. If the work of this Section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to correct conditions without extra charge.

1.11 REVIEW OF MATERIALS

- A. Submit to the ARCHITECT/ENGINEER for review within 90 days after award of contract a complete list of materials and equipment to be incorporated in the work, together with the name and addresses of the manufacturer's and their catalog numbers and trade names.
- B. The CONTRACTOR is not allowed to substitute manufacturers listed in the Form of Proposal after the bid is accepted.

1.12 SUBMITTALS

- A. Submit to the ARCHITECT/ENGINEER for review, as provided in the General Conditions, the manufacturer's shop drawings and technical literature covering details and installation of all new equipment, fixtures, and accessories being furnished under this Section prior to fabrication, assembly, or shipment.
- B. Shop drawings will be required on the following materials as applicable to this Project:
 - 1. Hangers and Supports - all types and sizes.
 - 2. Insulation - all types for piping, ductwork, etc.
 - 3. Markers and Tags.
 - 4. Piping, Valves, Pumps.
 - 5. Hydronic Specialties.
 - 6. Steam Specialties.
 - 7. Condensate Pumps.
 - 8. *Boilers.
 - 9. *Refrigerant Specialties.
 - 10. *Chemical Feed Equipment and Chemicals.
 - 11. *Louvers and Ventilators.
 - 12. *Chillers.
 - 13. *Cooling Towers.
 - 14. *Power Ventilators and Fans.
 - 15. *Unit Heaters.
 - 16. *Air Handlers.
 - 17. *Air Conditioners, Furnaces, Heat Pumps.
 - 18. *Refrigerant Leak Detection Unit.
 - 19. *Heat Pumps.
 - 20. *Unit Ventilators and PTAC units.
 - 21. *HVAC Control Devices and Systems.
 - 22. Training Outline.

- 23. Control Systems.
- 24. Duct Work.

* - A complete wiring diagram that relates specifically to this contract shall be included with submittal.

- C. Shop drawings shall be submitted only after the CONTRACTOR has checked and verified all field measurements, quantities, equipment dimensions, specified performance criteria, installation requirements, electrical requirements, materials, catalog numbers, and similar data with respect thereto and reviewed or coordinated each shop drawing with the requirements of the work and the Contract Documents.
- D. At the time of each submission the CONTRACTOR shall give the ARCHITECT/ENGINEER specific written notice of each variation that the shop drawings may have from the requirements of the Contract Documents.
- E. The shop drawings shall have a stamp or specific written indication that CONTRACTOR has satisfied the requirements stated herein before. Shop drawings submitted without the CONTRACTOR's review and stamp shall be immediately returned to the CONTRACTOR without the ARCHITECT/ENGINEER's review.

1.13 OPERATING AND MAINTENANCE MANUALS

- A. Four sets of O&M instructions and manuals shall be submitted in loose-leaf 3-ring cardboard reinforced vinyl binders to the ARCHITECT/ENGINEER in accordance with the General Conditions.
- B. Contained in each binder shall also be vendors, vendor phone numbers and addresses, list of materials, manufacturer's or vendor's web site, and materials parts list. Also included for each item shall be a copy of the approved shop drawing.
- C. The CONTRACTOR shall fill out the warranty card information (complete) for each and every piece of HVAC equipment and include a copy in each O&M manual.
- D. The O&M manual shall include each and every piece of HVAC equipment and accessories that a shop drawing was submitted on.

1.14 POWER SUPPLY

- A. Refer to Division 16 (except as noted herein).

1.15 SITE VISIT

- A. It shall be the responsibility of the bidder to visit the site before submitting his bid, and thoroughly note the conditions under which the work will be installed. No extra compensation will be later allowed for necessary work not figured that should have been foreseen.

1.16 REMOVAL OF EXISTING EQUIPMENT

- A. De-energize, remove and dispose off the site, the existing fans, pipes, pumps, unit heaters, tanks, ductwork, and all existing equipment shown except as noted on Drawings. This demolition work must be planned and scheduled so as not to leave the existing building unconditioned.

1.17 OPERATIONAL TEST

- A. After the various systems are completed and at which time the ARCHITECT/ENGINEER shall deem appropriate, the CONTRACTOR shall run an operation test for each system. The CONTRACTOR shall adjust all valves, equipment, controls and accessories so as to obtain maximum operating efficiency. Failure of any component to perform as specified shall constitute cause for rejection and removal.
- B. Some specific equipment may be noted to have the startup and checkout performed by an authorized representative of the manufacturer and a report submitted to the ENGINEER.

1.18 NOISE AND VIBRATION

- A. Install vibration isolators, flexible connectors, expansion joints, and other safety measures to prevent noise and vibration from being transmitted to occupied areas. Equipment shall be selected to operate within the noise level recommended for the particular type installation in relation to its location.
- B. Following installation, make proper adjustments to eliminate excessive noise and vibration.

1.19 CUTTING AND PATCHING

- A. Cutting and patching shall be held to an absolute minimum, and such work shall be done only under the direction of the ARCHITECT/ENGINEER or OWNER. The CONTRACTOR shall be responsible for and pay for all openings that may be required in the walls, floors, and roofs, and shall be responsible for putting said walls, floors, and roofs back in their original condition.

1.20 OWNER TRAINING

- A. The CONTRACTOR supplying equipment for this division shall provide the OWNER's operations staff with training in the operation and maintenance on the equipment being furnished. The training shall be conducted at the project site by a qualified representative of the manufacturer.
- B. The cost of this training shall be included in the bid price.
- C. The required training shall consist of both classroom and hands-on situation. Classroom training shall include instruction on how the equipment works, its relationship to all accessories and other related units, detailed review of shop drawings, detailed presentation of written O&M instructions, troubleshooting and record-keeping recommendations. Hands-on training shall include a review of the manufacturer's O&M instructions, check out of each operator to identify-

ing key elements of the equipment, tear down as appropriate, calibration, adjustment, greasing and oiling points, and operating manipulations of all electrical and mechanical controls.

- D. The training shall be scheduled through the CONTRACTOR with the OWNER. The timing of the training shall closely coincide with the startup of the equipment, but no training shall be conducted until the equipment is operational.
- E. The minimum number of training hours to be provided by manufacturers supplying equipment on this project shall be in accordance with the following table as applicable to this Project:

<u>Item</u>	<u>Minimum Training Hours*</u>	
	<u>Classroom</u>	<u>Hands-on</u>
Boiler/Chiller (each)	2	2
Heat Pumps/Air Conditioners	2	2
Energy Management System	2	2
HVAC Controls	2	2
Sprinkler System	1	2
Fans/Louver Dampers/Unit Heaters	2	2

* or until the OWNER is fully satisfied.

- F. At least 30 days prior to the training the manufacturer shall submit through the CONTRACTOR to the ENGINEER an outline of the training proposed for the ENGINEER's review and concurrence. The OWNER reserves the right to videotape all training sessions.

1.21 RECORD DRAWINGS

- A. The CONTRACTOR shall maintain 1 set of the Contract Drawings on the job in good condition for examination at all times. The CONTRACTOR's qualified representative shall enter upon these drawings, from day to day, the actual "as-built" record of construction and/or alteration progress with regards to HVAC, plumbing, and fire protection. Entries and notes shall be made in a neat and legible manner and these drawings delivered to the ARCHITECT/ENGINEER after completion of the construction, for use in preparation of Record Drawings.

1.22 WARRANTY

- A. The CONTRACTOR shall guarantee all work including equipment, materials, and workmanship. This guarantee shall be against all defects of any of the above and shall start from the date of project substantial completion and continue for a minimum of 1 year. All compressors for heat pump or air conditioning equipment, as a baseline standard, shall have an additional 4-year parts only warranty beyond the CONTRACTOR'S 1-year parts and labor warranty for all equipment. Other items listed throughout Division 15 may have longer warranty requirements-see individual equipment specifications.

- B. Repair and maintenance for the guarantee period is the responsibility of the CONTRACTOR and shall include all repairs and maintenance other than that which is considered as routine. (That is replacement of filters, oiling, greasing, etc.) The ENGINEER shall be the judge of what shall be considered routine maintenance.
- C. See General Conditions for additional requirements.

1.23 SEISMIC CONSIDERATIONS

- A. Since this project is in Seismic Zone B, the CONTRACTOR shall be sure that all supports are consistent with the most recent state and local code requirements in this regard.

END OF SECTION

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, and services required to install the identification products as specified herein.

1.02 RELATED WORK

- A. Mechanical insulation is included in this Division, Section 15260.
- B. Plumbing pipe is included in this Division.
- C. Ductwork is included in this Division, Section 15890.

1.03 SUBMITTALS

- A. Shop drawings and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ENGINEER in accordance with the General Conditions.
- B. Submit list of working symbols, letter size, and color coding for mechanical identification. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 PRODUCTS

2.01 MARKERS

- A. Colors unless specified otherwise shall conform with ANSI/ASME A13.1.
- B. Plastic nameplates shall be laminated three-layer plastic with engraved black letters on light contrasting background color.
- C. Plastic tags shall be laminated three-layer plastic with engraved black letter on light contrasting background color. Tag size minimum 1-1/2 inch diameter/square.
- D. Metal tags shall be brass or aluminum with stamped letters. Tag size shall be minimum 1-1/2 inch diameter with smooth edges.
- E. Stencils shall have the following size letters:

<u>*Outside Diameter of Pipe</u>	<u>Arrow Length x Width (Inches)</u>	<u>Size of Letters (Inches)</u>
Less than 1-1/2	1-1/2 x 1/2	1/2
1-1/2 - 2	4 x 1	3/4
2-1/2 - 6	8 x 2	1-1/4
8 - 10	12 x 3	2-1/2
Over 10	20 x 5	3-1/2
Ductwork & Equipment	12 x 3	2-1/2

*Including insulation if applicable.

- F. Stencil paint shall be in accordance with paint specification contained herein.
- G. Plastic pipe markers shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.
- H. Plastic tape pipe markers shall be flexible vinyl film tape with pressure sensitive adhesive backing and printed markings.
- I. Underground plastic pipe markers shall be bright colored continuously printed plastic ribbon tape of not less than 6-inch wide by 4-mil thick, manufactured for direct burial service.

2.02 PAINTING

- A. All piping that is exposed or located in accessible pipe chases shall be painted.
- B. The paint system to be used shall be recommended by the manufacturer for the particular surface to be painted and certified by the manufacturer for long term compatibility of all coatings with all substrates, both new and existing. Shop drawing submittal shall contain sufficient information to confirm the compatibility of the paint system for the surface to be painted and manufacturers recommendations for application.
- C. Where prime coats are required they shall be of the same manufacture as the finish coat.
- D. Painting systems shall be as manufactured by Rustoleum Corp., Porter International, Sherwin-Williams, or equal.
- E. Colors shall be in accordance with ANSI A13.1 unless otherwise specified in the following table:

COLOR CODES/MARKING FOR PIPE

<u>Service</u>	<u>Pipe Color</u>	<u>Arrow</u>	<u>Marking</u>
Cold Water (potable)	Blue	Black	POTABLE
Hot Water supply	Light Green	Red	HW
Hot water return	Light Green	Red	HWR
High temperature water supply	Dark Green	Red	HTWS
High temperature water return	Dark Green	Red	HTWR
Boiler feed water	Dark Gray	White	BF
Fire protection water	Red	Black	FIRE
Condenser water supply	Tan	Black	COND WS
Condenser water return	Tan	Black	COND WR
Chilled water supply	Tan	Light Green	CHWS
Chilled water return	Tan	Light Green	CHWR
Compressed air	Purple	White	COMP AIR
Natural gas	Yellow	Brown	NAT GAS
Fuel oil	Black	White	FUEL OIL
Steam	Orange	Black	STEAM
Condensate	Light Gray	Light Green	COND
Drainage, Waste, Vent	Brown	Brown	DWV

PART 3 EXECUTION**3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials. Prepare surfaces to be painted in accordance with manufacturer's instructions.

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- B. Install plastic or metal tags with corrosive resistant chain.
- C. Apply stencil painting in accordance with paint manufacturer's instructions.
- D. Plastic pipe markers shall be installed in accordance with manufacturer's instructions.
- E. Underground plastic pipe markers shall be installed 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify all fans, louvers, unit heaters, packed AC and heat pump units, air handling units, controls, pumps, test transfer equipment, tanks, and water treatment devices with plastic nameplates and stencil painting. Small devices, such as in-line pumps, may be identified with plastic/metal tags.
- G. All control panel and major control components outside panels with plastic nameplates.

- H. Identify all valves in main and branch piping with tags.
- I. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers, stenciled painting or tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T," at each side of penetration of structure or enclosure, at each obstruction, fitting and change of direction.
- J. Identify ductwork with plastic nameplates or stenciled painting. Identify as to air handling unit number, and area served. Locate identification at air handling unit, at each side or penetration of structure or enclosure, and at each obstruction.
- K. Surfaces to be painted shall be cleaned, primed, and painted in strict conformance with paint manufacturer's instructions.

3.03 VALVE CHART AND SCHEDULE

- A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed.

END OF SECTION

SECTION 15830

UNIT HEATERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to install unit heaters as shown on the Contract Drawings and as specified herein. Heating and air delivery capacities are specified in the heater schedule in the Drawings.

1.02 RELATED WORK

- A. Special requirements for materials and equipment are given in Section 15010 and the General Conditions.
- B. Electrical work is specified in Division 16.
- C. Controls are specified this Division, Section 15950.
- D. OWNER training for HVAC equipment is specified in Section 15010.

1.03 QUALIFICATIONS

- A. Manufacturer's shall be regularly engaged in manufacturer of unit heaters of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.04 SUBMITTALS

- A. Shop drawings and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.
- B. Submit ladder-type wiring diagrams for power and control wiring required for final installation of unit heaters. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. O&M instructions shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.

1.05 WARRANTY

- A. Furnish manufacturer's one year warranty for each unit heater. Other warranty requirements are included in the equipment's description.

PART 2 PRODUCTS

2.01 ELECTRICAL HORIZONTAL UNIT HEATER

- A. Heaters shall have electrical characteristics and capacities as shown in the heater schedule on the Contract Drawings.

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- B. Unit heaters shall have a housing of 18 gauge die-formed steel, with a phosphate coating to resist corrosion, and finished with a baked-on enamel. The heater shall be of the pull-through air design or contain a heating element which fits the entire shroud to assure that all incoming air passes through the heating element. Heating elements shall be of the metal sheath finned type heat bank or cast aluminum heating grid with automatic reset thermal overload protection. The product shall be guaranteed by the manufacturer for a period of 1 year under normal operating conditions. Fan motors shall be totally enclosed continuous duty with built-in thermal overload protection and shall be controlled by a fan delay switch to prevent cold drafts and distribute heat after element shuts off.
- C. All heaters shall be equipped with front directional louvers for positive control of discharge air and shall be mounted to the wall utilizing a swivel type mounting bracket accessory.
- D. Electric horizontal unit heaters shall be 5100 Series as manufactured by Markel.

PART 3 EXECUTION

3.01 INSTALLATION OF ELECTRIC UNIT HEATERS

- A. Install electric unit heater on support brackets furnished with the unit. Secure to structural support as required.
- B. Locate heater so that clearance from combustible materials, as recommended by the manufacturer, is maintained.
- C. Make all electrical connections for power and controls.
- D. Check heater for proper operation, including safety controls.
- E. Bottom of unit heaters shall be a minimum of 9 feet above the finished floor.

END OF SECTION

SECTION 15862

POWER VENTILATORS AND FANS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to install Power Supply and Exhaust Ventilators as shown on the Contract Drawings and as specified herein.
- B. Ventilators and fans shall have electrical characteristics and capacities as shown in the ventilation schedule on the Contract Drawings.
- C. All belt drive type ventilators shall have automatic belt tensioners.

1.02 RELATED WORK

- A. Special requirements for materials and equipment are given in the General Conditions
- B. Electrical work is specified in Division 16.
- C. Duct work and accessories is described in this Division, Section 15890. D. Controls are described in this Division, Section 15950.
- D. OWNER training for HVAC equipment is specified in Section 15010.

1.03 QUALIFICATIONS

- A. All ventilation equipment shall bear the AMCA certified rating seal and shall be listed in the latest edition of the AMCA Directory.

1.04 SUBMITTALS

- A. Shop drawings and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.
- B. O&M instructions shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.

1.05 WARRANTY

- A. Furnish manufacturer's 1 year warranty for all power ventilators. See individual equipment descriptions and Section 15010 for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Ventilators and fans shall have electrical characteristics and capacities as shown in the ventilation schedule on the Contract Drawings.

2.02 WALL TYPE EXHAUST VENTILATOR (INTERIOR MOUNTED)

- A. Fan shall be a wall mounted, belt driven steel propeller exhaust fan with integral housing. Unit shall include exterior weatherhood with bird screen, heavy duty aluminum motorized discharge shutter, flanged wall collar, toggle disconnect, mounting angles, automatic belt tension device, and OSHA inlet guard. Shutter shall include transformer if required, depending on operator voltage.
- B. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705).
- C. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a tubular steel power assembly. The power assembly shall be bolted to a minimum 14 gauge wall panel with continuously welded corners and an integral vent. Fan shall be enclosed in minimum 18 gauge galvanized steel wall housing with factory installed shutter and inlet guard. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan rpm. Unit shall be shipped in ISTA certified transit tested packaging.
- D. All non-galvanized steel fan components shall be coated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a 5- stage, environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.
- E. Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7 gauge hub. The hub shall be keyed and locked to the fan shaft utilizing 2 setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- F. Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

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- H. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan rpm.
- I. Packaged wall exhaust fan shall be type (XLPH) as noted in the equipment schedule and as manufactured by Loren Cook Company of Springfield, Missouri.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all required backdraft or motorized dampers as called for in the fan schedule and check to make sure they are free to open and close.
- B. Check rotation of all fans.
- C. Adjust belt tensioners in belt drive units to properly load the belt(s). All fasteners shall be of non-magnetic stainless steel.
- D. Insulate the gap between the fan wall housing and the wall opening to prevent air leakage. Cover the gap on the room interior by installing a thick aluminum perimeter frame all around the unit.

END OF SECTION

SECTION 15910
LOUVERS AND VENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment, and services required to install louvers and vents as shown on the Contract Drawings and as specified herein.
- B. CONTRACTOR shall coordinate all louver and vent openings with the Architectural/Structural Drawings. Should a conflict be discovered between the Architectural/Structural Drawings and the Mechanical Drawings, the CONTRACTOR shall notify the ARCHITECT/ENGINEER immediately. No additional costs will be allowed to the CONTRACTOR should he fail in properly coordinating louver locations with Architectural Drawings.
- C. See the Drawings and/or equipment schedule for additional requirements.

1.02 RELATED WORK

- A. Special requirements for materials and equipment are given in the General Conditions.
- B. Electrical work is specified in Division 16.
- C. Controls are described in this Division, Section 15950.

1.03 QUALIFICATIONS

- A. All equipment in this Section shall bear the AMCA certified rating seal and shall be listed in the latest edition of the AMCA Directory.

1.04 SUBMITTALS

- A. Shop drawings and other items needed to establish compliance with the Drawings and these Specifications shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.
- B. O&M instructions shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.
- C. Submit manufacturer's certified test data, where applicable, and installation instructions for required products including finishes.

1.05 WARRANTY

- A. Furnish manufacturer's 1 year warranty for all louvers and vents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Louvers and vents shall be manufactured by Ruskin Manufacturing Company.

2.02 MOTORIZED COMBINATION LOUVER/DAMPER

- A. The unitized louver/damper shall be 6 inches deep and assembled completely by welding. Stationary blades shall be 12 gauge (.081 inch) extruded aluminum alloy 6063-T52. The adjustable blades and frame will be 8 gauge (.125 inch) extruded aluminum, alloy 6063-T52. Adjustable blades shall pivot in nylon bearings on 1/2-inch diameter aluminum pins with operating mechanism in each jamb frame. The louver/damper shall have drainable blades with downspouts in jambs and mullions. All materials shall be factory finished after assembly. See equipment schedule for required factory finish.
- B. The louver/damper shall bear AMCA certified rating seals for air performance, water penetration and air leakage ratings. Air leakage will not exceed 2.8 scfm/ft² of louver area at a static pressure of 1.5-inch w.g. Water penetration shall be no more than .025 ounces per square foot of free area at an air flow of 1,000 fpm free area velocity when tested for 15 minutes per AMCA standard 500. The louver shall provide a minimum of 7.88 square feet of free area in a 4-foot x 4-foot section. The section shall pass 1,200 fpm free area velocity at a pressure drop not exceeding .15-inch w.g.
- C. The louver/damper shall be equipped with a factory-mounted electric operator with auxiliary switch and spring return and will be complete with all linkage and mounting hardware required. The motor shall be Barber-Colman 400 Series, unless required to be otherwise based on service or control requirements noted or shown in the Drawings. See electrical drawings for voltage requirements.
- D. A mesh aluminum insect or 16 B&S gauge x 3/4-inch diamond pattern expanded aluminum bird screen with removable frame as noted on the ventilation schedule will be fitted to the unit. Other accessories will be as indicated on the ventilation schedule on the Drawings.
- E. Combination louver/dampers shall be manufactured by the Ruskin Manufacturing Company.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Locate and place louver units plumb, level, and in proper alignment with adjacent work.
- B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

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- C. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry, or dissimilar metals.
- D. Caulk all perimeter with silicone to make edge insect proof and watertight.
- E. Use non-ferrous stainless steel fasteners for all exterior applications.
- F. Test operation and adjust the counterbalance to the proper air pressure for gravity dampers.
- G. CONTRACTOR shall install appropriate lintels as described in the structural section of the Contract Drawings. If not described, submit request for lintel sizing during shop drawing review.

END OF SECTION

SECTION 15950
BASIC HVAC CONTROLS

PART 1 GENERAL

1.01 GENERAL

- A. HVAC control devices shall be wired by the Electrical Contractor. All electrical wiring for control systems and power wiring to equipment shall be as described in the Electrical Sections of the Contract Drawings and Specifications. The control method and device(s) to be used shall be as described in the equipment schedules or sheet notes on the Drawings.

1.02 QUALIFICATIONS

- A. Control components shall be manufactured by Johnson Controls, Barber Coleman, Chromalox, Honeywell, White-Rodgers, the equipment manufacturer, or equal. Other specific control components may be called for in the equipment schedules on the Contract Drawings.

1.03 SUBMITTALS

- A. Detailed shop drawings shall be submitted for each control device. Shop drawings shall include complete wiring diagrams, and operating descriptions. Clearly indicate the application for each thermostat. Shop drawings shall be submitted to the ARCHITECT/ENGINEER in accordance with Section 15010 and the General Conditions.

PART 2 PRODUCTS

2.01 THERMOSTATS

- A. Thermostats shall be line voltage or low voltage type suitable to application. Thermostats shall be suitable for heating and/or cooling as required by the application. Thermostats shall be as specified in the equipment schedules on the Contract Drawings.

2.02 OTHER PRIMARY CONTROL DEVICES

- A. See the appropriate equipment schedule on the Contract Drawings for additional requirements regarding the following items to be furnished and installed: Break-glass type emergency off switch, HOA switch, ON/Off toggle switch, pilot lights, etc., and other miscellaneous control system components.
- B. CONTRACTOR shall include all power and control wiring and conduit as well as relays, transformers, junction boxes, contacts, enclosures, incidentals, and miscellaneous accessories as required to install a complete system to provide the control functions and operation as described or noted.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. Mount all thermostats approximately 60 inches above finished floor unless otherwise noted.
- B. See electrical control circuits in the Electrical Section of the Contract Drawings for additional control operation descriptions and requirements.
- C. All HVAC controls shall be located as shown on the mechanical drawings and shall override any conflicts when shown elsewhere on the electrical drawings.

END OF SECTION

SECTION 15990

BALANCING, TESTING, AND ADJUSTING OF HVAC SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and services required to test, balance, and adjust installed HVAC systems and equipment as shown on the Contract Drawings and as specified herein.
- B. After the systems have been completely installed, all equipment shall be carefully tested, balanced, and adjusted. Adjust all dampers, registers and air diffusers for air flow and make an accurate velometer test of air quantities delivered and removed from each opening. Any readjustments in the motor, drives, units, controls and other equipment found to be necessary shall be made without additional cost and the entire system shall be placed in a satisfactory operating condition.
- C. Equipment that does not perform as specified shall be adjusted per the manufacturer's instructions by the CONTRACTOR and retested. This includes all equipment where the capacity exists for adjustment such as multi-speed direct drive motors and belt driven equipment. Proof of these adjustments shall be noted in the report.
- D. See the general mechanical notes applicable to all HVAC in the Contract Drawings for additional requirements.

1.02 QUALIFICATIONS

- A. The testing firm shall have at least 3 years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project, who is not Installer of systems to be tested and is otherwise independent of project. The firm shall be certified by Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines similar to those required for this Project. The ENGINEER may pre-approve a test and balance firm not certified by AABC or NEBB, but only prior to the bid opening.
- B. Measurements, instruments, testing, adjusting, and balancing shall comply with the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. recommendations for such testing.

1.03 SUBMITTALS

- A. Submit certified test reports signed by Test and Balance Supervisor who performed TAB work. The reports shall include identification and type of instruments used and their most recent calibration date with submission of final test report.

- B. Reports shall contain the following general data in a format selected by the balancing contractor.

- | | |
|-----------------------------------|--------------------------------|
| 1. Project Number | 6. Test & Balance Agency |
| 2. Contract Number | 7. Test & Balance Engineer |
| 3. Project Title | 8. General Contractor |
| 4. Project Location | 9. Mechanical Subcontractor |
| 5. Project Architect/
Engineer | 10. Dates Tests were Performed |
| | 11. Certification |

- C. Test data typical to each category of equipment shall be reported in a format in accordance with AABC or NEBB guidelines but as a minimum shall include the following items as applicable:

- | | |
|------------------------------|--|
| 1. Static Pressure | 11. Serial number |
| 2. Airflow velocity and CFM | 12. Sheave make, diameter, bore,
distance |
| 3. GPM | 13. Filter size |
| 4. Name plate data | 14. Model number |
| 5. Multi-speed motor setting | 15. Diffuser/grille size |
| 6. Equipment tag | 16. Location/area/room served |
| 7. Motor size (HP) | 17. Design data/performance |
| 8. Motor amperage | |
| 9. Motor RPM | |
| 10. Fan RPM | |

- D. The CONTRACTOR shall provide access to **all** HVAC equipment to accomplish the scope of work described in this Section. A notation of "equipment not accessible" in the report is not acceptable. The CONTRACTOR shall provide a means to make all equipment accessible to the T & B contractor.

PART 2 EXECUTION

2.01 JOB CONDITIONS

- A. Do not proceed with testing, adjusting, and balancing work until work has been completed and is operable. Ensure that there is no latent residual work still to be completed.
- B. Do not proceed until work schedule for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.
- C. Patch holes in insulation ductwork and housings which have been cut or drilled for test purposes, in manner recommended by original Installer.
- D. All equipment settings shall be marked to show final settings at completion of TAB work.
- E. Prepare a report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced; including where necessary, modification which exceed requirements of Contract Documents for

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mechanical work. Retest, adjust, and balance systems subsequent to significant system modification and resubmit test results at no additional cost to OWNER.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Work included in this section of the Specifications includes the furnishing of all labor, material, tools, approvals, utility fees, excavation, backfill, and other equipment and services necessary to install the electrical system as shown on the Contract Drawings and as specified herein. It also includes the connection of all equipment included in this Contract but furnished by other contractors or suppliers.
- B. The Contractor shall furnish and install all conduit, wire, safety switches and miscellaneous material to make all electrical connections to all items of equipment or wiring devices indicated in the Drawings or Specifications except as otherwise specified.
- C. All devices and items of electrical equipment, including those shown on the Contract Drawings but not specifically mentioned in the Specifications or those mentioned in the Specifications but not shown on the Contract Drawings, are to be furnished under this section of the Specifications. Any such device or item of equipment, if not defined in quality, shall be equal to similar equipment and/or devices specified herein.
- D. Bidders are required to visit the construction site prior to submitting a bid and carefully examine the Contract Drawings and Specifications so that he/she may fully understand what is to be done and to document existing conditions. Any discrepancies, questions, or omissions must be brought to the attention of the Engineer at least 10 days prior to the bid opening date. Extras will not be approved for work that the Contractor should have seen beforehand by visiting the site prior to bidding.
- E. It is the general intent that all motors (except for replacement motors) shall be furnished with the particular object of equipment it drives by the supplier furnishing the equipment. Motor controls and related equipment shall be furnished by the Division 16 supplier unless specifically noted otherwise in these Specifications or on the Drawings.
- F. Where wiring diagrams are not shown on the Contract Drawings, they shall be provided by the supplier of the equipment served and such diagrams shall be adhered to except as herein modified.

1.02 RELATED WORK

- A. Division Zero and 1: Contractors bidding work under this Contract shall read and understand Division Zero and Division 1 - General Requirements.

If any discrepancies are discovered between the Basic Electrical Requirements and the above-mentioned documents, the above-mentioned documents shall overrule this section. The Basic Electrical Requirements are intended as a supplement to the above-mentioned documents. The Contractor shall bid as outlined in the above mentioned Specifications and shall be governed by any alternates or unit prices called for in the form of proposal.

- B. Contractor shall carefully examine the entire set of Contract Drawings and all Divisions of the Specifications.

1.03 SUBMITTALS

- A. Shop Drawings including descriptive literature and/or installation, operation and maintenance instructions shall be submitted in the amount of copies per the General Conditions for this Division. All Shop Drawings shall be submitted in loose-leaf three-ring cardboard reinforced vinyl binders. A shop drawing submittal shall be prepared for each Section of this Division.
- B. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted. Non-applicable catalog data shall be marked out. Product literature with one or more styles / configurations for a single product shall have a written description of use for each of the styles / configurations represented on the literature. For example: Device boxes – Styles shall be listed as: For masonry walls, for electrical devices, for ceiling mounted light fixtures, etc. Proposed options must be highlighted, underlined, etc.
- C. The Engineer reserves the right to make modifications to motor control and power distribution equipment ratings after equipment Shop Drawing review, if the equipment Shop Drawings are submitted prematurely (prematurely meaning submitted before all utilization equipment has been reviewed and accepted). Cost of modifications shall be the Contractor's responsibility.
- D. O&M manuals must be submitted for all equipment. The O&M manuals shall be assembled in three-ring binders with front and binder-edge labels. The first and last few pages shall have sheet hole protectors to prevent the pages from tearing out. O&M manuals must include the following information:
 - 1. Vendor and contractor information, addresses, phone numbers, email, websites, etc.
 - 2. Equipment cutsheets with detailed model number breakdown suitable for procuring replacement equipment. It is best to insert the approved shop drawing cutsheets into the O&M manuals, unless field changes necessitate otherwise. Non-applicable

information must be marked out, and selected options must be highlighted.

3. Operation instructions
4. Maintenance instructions
5. Drawings, wiring diagrams, etc.
6. Copy of required testing results
7. Copy of inspection certificates
8. A compact disc holder with compact disc containing a PDF format copy of all O&M information. At Contractor's option, a CD can be submitted (in the quantity required for O&M manuals) containing the O&M information for the entire electrical system rather than with each O&M manual.

- E. AutoCAD floor plans are available in electronic format for a fee of \$100 per sheet. Contact the Engineer to obtain these floor plans.

1.04 SYMBOLS AND ABBREVIATIONS

- A. The symbols and abbreviations generally follow standard electrical and architectural practice; however, exceptions to this shall be as shown on the Contract Drawings.

1.05 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate the electrical work with that of other trades to ensure proper final location of all electrical equipment and/or connections. The Contractor shall verify door swings to see that light switches are located properly.

1.06 CODES

- A. The minimum standard for all work shall be the latest revision of the Kentucky Building Code (KBC) and the National Electrical Code (NEC). Whenever and wherever state and/or local laws or ordinances and/or regulations and/or the Engineer's design require a higher standard than the current NEC or KBC, then these laws and/or regulations and/or the design shall be followed.

1.07 INSPECTIONS AND PERMITS

- A. Inspection of the electrical system on all construction projects is required. It is the Contractor's responsibility to pay for and obtain all permits, pay all fees, and coordinate the activity of inspections. The Contractor shall notify the electrical inspector in writing, immediately upon notice to proceed, and a copy of the notice shall be submitted to the Engineer. No work shall be concealed unless acceptable to the inspector.
- B. At the time of completion of the project, there shall be furnished to the Owner a certificate of compliance, from the agency having jurisdiction

pursuant to all electrical work performed. The Engineer shall also receive a copy in the O&M manual submittal.

1.08 STORAGE

- A. All work, equipment, and materials shall be protected against dirt, water, or other injury during the period of construction.
- B. Sensitive electrical equipment such as light fixtures, motor starters, control panels, and panelboards, delivered to the job site, shall be protected against injury or corrosion due to atmospheric conditions or physical damage by other means. Protection is interpreted to mean that equipment shall be stored under roof, in a structure properly heated in cold weather and ventilated in hot weather. Provision shall be made to control the humidity in the storage area to 50 percent relative. The stored equipment shall be inspected periodically, and if it is found that the protection is inadequate, further protective measures shall be employed. Electrical equipment other than boxes and conduit shall not be installed until the structure is under roof with doors and windows installed.
- C. No light fixtures or device plates shall be hung or installed until after painting is completed.

1.09 ERRORS, CORRECTIONS, AND/OR OMISSIONS

- A. Should a piece of equipment be supplied of a different size or horsepower than shown on the Contract Drawings, the Contractor shall be responsible for installing the proper size wiring, conduit, starters, circuit breakers, etc., for proper operation of that unit and the complete electrical system at no extra cost to the Owner.
- B. It is the intent of these Specifications to provide for an electrical system installation complete in every respect, to operate in the manner and under conditions as shown in these Specifications and on the Contract Drawings. The Contractor shall notify the Engineer, in writing, of any omission or error at least 10 days prior to opening of bids. In the event of the Contractor's failure to give such notice, he/she may be required to correct work and/or furnish items omitted without additional cost. Further requirements on this subject may be found in the General Requirements.
- C. Necessary changes or revisions in electrical work to meet any code or power company requirement shall be made by the Contractor without additional charge.

1.10 GUARANTEES AND WARRANTIES

- A. The Contractor shall guarantee all work including equipment, materials, and workmanship. This guarantee shall be against all defects of the electrical system or improper equipment operation. It shall last for the period of time specified in the General Conditions of the Contract, but not less than one year from the date of substantial completion.
- B. Repair and maintenance for the guarantee period is the responsibility of the Contractor and shall include all repairs and maintenance other than that which is considered as routine. (That is oiling, greasing, etc.) The Engineer shall be the judge of what shall be considered as routine maintenance.
- C. Certain equipment is required to have longer warranty periods than that specified in the General Conditions. See the individual sections for these warranty requirements.

1.11 POWER COMPANY COORDINATION

- A. The Contractor is responsible for coordinating all activities onsite by the power company. The Contractor is responsible for paying for any fees charged by the electrical utility to disconnect/reconnect power as needed.
- B. Any special provisions required by the serving electrical utility shall be as outlined on the Contract Drawings or as advised by the utility at the time of construction, and work required by these special provisions shall be executed with no extra cost to the Owner.

1.12 TEMPORARY ELECTRICAL POWER AND LIGHTING

- A. The Contractor shall be responsible for providing temporary electrical power and lighting as required during the course of construction and shall remove the temporary service equipment when no longer required. Temporary power is also addressed in general and special requirements.

1.13 TRAINING

- A. All manufacturers supplying equipment for this division shall provide the Owner's operations staff with training in the operation and maintenance on the equipment being furnished. The training shall be conducted at the project site by a qualified representative of the manufacturer. Refer to individual equipment specifications for training requirements.

1.14 RECORD DRAWINGS

- A. The Contractor shall maintain 1 set of the Contract Drawings on the job in good condition for examination at all times. The Contractor's qualified representative shall enter upon these drawings, from day to day, the

actual record of construction and/or alteration progress. Entries and notes shall be made in a neat and legible manner and these drawings delivered to the Engineer after completion of the construction, for use in preparation of Record Drawings.

- B. Specific attention shall be given to the exact location of any underground lines installed under this Contract. These lines shall be dimensioned to easily identifiable points on permanent structures.

1.15 MAINTAINING CONTINUOUS ELECTRICAL SYSTEM AND SERVICE

- A. Existing service(s) continuity shall be maintained at all times. In no way shall the installation and/or alteration of the electrical work interfere with or stop the normal operation of the existing facilities, except where acceptable to the Owner and prior arrangements have been made.
- B. When additions and taps to existing service(s) require electrical outages, arrangements shall be made in advance for such outages. All outages shall be held to an acceptable minimum with none exceeding 8 hours continuous duration. If necessary, cuts shall be performed on premium time. If performed at night, requiring a general outage, the Contractor shall furnish an auxiliary source of light and power as required. Under no circumstances shall an electrical outage of any duration be initiated until the Owner and Engineer have concurred, and as far as possible in advance.

1.16 SERVICE ENTRANCE

- A. Conductors and terminations for service entrances shall be furnished and installed by the Contractor. Voltage, phase, and number of wires shall be as shown on the Drawings. Clearances for overhead entrance wires shall be per Power Company, NEC, and NESC requirements.
- B. Any details not shown on the Drawings or written in the Specifications pertaining to the service entrance shall be installed per NESC and power company requirements. It is the Contractor's responsibility to contact the utility prior to bidding and obtain any special requirements or costs they will be imposing. Those costs shall be included in the bid.

1.17 CONTRACTOR LICENSING

- A. The Contractor performing the electrical work on this project shall be a licensed electrical contractor in the state of Kentucky.

1.18 RECEIPTS

- A. Some sections of the Specifications call for equipment, materials, accessories, etc. to be provided and "turned over to the Owner" or like requirements. The Contractor shall obtain a receipt for each item turned

over, signed by the Owner or his representative. A copy of this receipt shall be transmitted to the Engineer.

- B. When a question arises concerning whether items have been turned over to the Owner, and there is no signed receipt, it may be assumed that the items were not provided.

1.19 DEFINITIONS

- A. Furnish – Procure equipment/materials and deliver and unload at the project site.
- B. Install – Enter the equipment/materials permanently into the project and make operational.
- C. Provide – Furnish and Install
- D. NEC – National Electrical Code

1.20 HAZARDOUS LOCATIONS

- A. Not applicable on this project.

1.21 EQUIPMENT CONFIGURATION/PROGRAMMING

- A. Any equipment furnished by the Contractor is required to be configured or programmed by the Contractor or his subcontractor/vendor. Any necessary studies or engineering necessary to configure or program this equipment shall be provided by the Contractor as needed to place the equipment into successful operation. Engineer or Owner will not be responsible for equipment configuration or programming.
- B. If a manufacturer or manufacturer's representative is required to startup/commission the equipment in these Specifications, then it is required that the Contractor provide the services of the manufacturer to configure/program the equipment. This includes the provision of any necessary studies or engineering necessary for the configuration/programming.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials used shall be new and at least meet the minimum standards as established by the NEC and/or National Electrical Manufacturers Association (NEMA). All materials shall be UL listed for the application, where a listing exists. All equipment shall meet applicable FCC requirements and restrictions.

- B. The reuse of salvaged electrical equipment and/or wiring will not be permitted unless specified herein or indicated on the Contract Drawings.
- C. All abandoned electrical materials shall be removed from the job site upon completion of the project, unless otherwise noted on the Contract Drawings or specified herein.
- D. All materials must be rated for the temperature range expected to be encountered in the application indicated on the Drawings. If there are any questions regarding the temperature range, contact the Engineer 10 days prior to bid opening date. No extras will be allowed for materials proposed that do not have an acceptable temperature range.

2.02 OVERCURRENT AND OVERLOAD PROTECTION

- A. Circuit breakers or fused switches shall be the size and type as written herein and shown on the Contract Drawings. Any additional overcurrent protection required to maintain an equipment listing by an authority having jurisdiction shall be installed by the Contractor at no extra cost to the Owner.
- B. The Contractor shall submit actual nameplate data from motors shipped to the site, stating motor identification as well as characteristics. Overload relay thermal unit selection tables shall accompany the motor data. The Contractor shall select and highlight thermal unit sizes from this data and shall include this information in the O&M Manuals.

2.03 STEEL COVER PIPE

- A. Steel cover pipe shall be furnished and installed as a sleeve to protect conduits that travel under roads or in boring/jacking installations. Pipe shall be plain end steel pipe with yield strength of 35,000 psi minimum and tensile strength of 60,000 psi minimum. It shall be manufactured per API-5L specifications. Minimum wall thickness shall be .188" under 10" size and .25" for 10" or 12" size.

PART 3 – EXECUTION

3.01 GENERAL ELECTRICAL INSTALLATION

- A. Equipment connections shall be made with flexible or rigid conduit as required. Controllers for motors, safety switches, and all control, protective and signal devices for motor circuits, except where such apparatus is furnished mounted and connected integrally with the motor driven equipment, shall be installed, connected and left in operating condition. The number and size of conductors between motors and control or protective apparatus shall be as required to obtain the operation described in these Specifications, and/or by the Contract Documents, and/or as shown in manufacturer-furnished Engineer reviewed Shop Drawings.

3.02 CUTTING AND PATCHING

- A. Cutting and patching shall be held to an absolute minimum and such work shall be done only under the direction of the Owner's representative. The Contractor shall be responsible for and shall pay for all openings that may be required in the floors or walls, and he shall be responsible for putting said surfaces back in their original condition. Every attempt shall be made to avoid cutting reinforcing steel bars when an opening is required in a reinforced concrete wall or floor slab.
- B. Prior to cutting of any floors or walls, all conduits must be located prior to the cutting through the use of sounding test equipment. Such equipment is readily available through local electrical companies and other sources. If a pipe or electrical circuit is damaged during cutting/demolition the Contractor shall repair the damaged item back to original condition. Absolutely no extras will be allowed for the replacement of damaged electrical conduits, pipes, etc. in floors walls, and ceilings that are to remain.

3.03 CLEANUP

- A. Cleanup shall be completed as soon as possible after the electrical installation is complete and as required throughout the project construction by the Owner. All equipment supplied under this Division shall be free of shipping tags, dust, stickers, shavings, filings, drill cuttings, etc. All painted equipment shall be left free of scratches or other blemishes, such as splattered or blistered paint, etc. Surplus material, rubbish and equipment resulting from the work shall be removed from the job site by the Contractor upon completion of the work. All existing equipment must be thoroughly cleaned by the Contractor in the vicinity of the construction area.
- B. During construction, cover all Owner equipment and furnishings subject to damage or contamination in any way.

3.04 EXCAVATION AND BACKFILL

- A. Excavation for conduits shall be of sufficient width to allow for proper jointing and alignment of the type conduit used. Conduit shall be bedded on original ground. Where conduit is in solid rock, a 6-inch earth cushion must be provided. Conduit shall be laid in straight lines between pull boxes and/or structures unless otherwise notes on the Contract Drawings. The cost of solid rock excavation shall be included in the lump sum bid with no extra pay allowed (unclassified).
- B. Backfill shall be as detailed on the Drawings. Dirt within 6" of the conduits shall be hand placed, loose granular earth. It shall be free of rocks over ½ inches in diameter. Above 6", large rocks may be included but must be mixed with sufficient earth to fill all voids.

3.05 SLEEVES, CHASES AND OPENINGS

- A. Sleeves shall be required at all points where exposed conduits pass through new concrete walls, slabs, or masonry walls. Sleeves that must be installed below grade or where subject to high water conditions must be installed watertight.
- B. Wiring chases shall be provided where shown on the Contract Drawings. The Contractor shall have the option of installing chases below surface mounted panelboards provided all structural requirements are met.
- C. It is the Contractor's responsibility to leave openings to allow installation of the complete, operational electrical system. Openings required but not left shall be cut as outlined under cutting and patching. The Contractor shall coordinate all holes and other openings with necessary diameters for proper firestopping.

3.06 GROUNDING AND BONDING

- A. All metallic conduit, cabinets, equipment, and service shall be grounded in accordance with the latest issue of the National Electrical Code. All supporting framework and other metal or metal clad equipment or materials which are in contact with electrical conduit, cable and/or enclosures, shall be properly grounded to meet the code requirements.

3.07 ANCHORING/MOUNTING

- A. Electrical conduits and/or equipment shall be rigidly supported. Anchors used shall be metallic expansion type, or if appropriate to prevent spalling concrete, epoxy set type. Plastic or explosive type anchors are prohibited.
- B. Contractor shall provide all necessary supports in accordance with KBC Seismic requirements.

3.08 ELECTRICAL COMPONENT MOUNTING HEIGHTS

- A. Unless otherwise indicated, mounting height for components shall be as defined on the Drawings.

3.09 TESTING

- A. After the wiring system is complete, and at such time as the Engineer may direct, the Contractor shall conduct an operating test for acceptance. The equipment shall be demonstrated to operate in accordance with the requirements of these Specifications and the Contract Drawings. The test shall be performed in the presence of the Engineer or his authorized representative. The Contractor shall furnish all instruments and personnel required for the tests, as well as the necessary electrical power.

- B. Before energizing the system, the Contractor shall check all connections and set all relays for proper operation. He/she shall obtain all necessary clearances, approvals, and instructions from the serving utility company and/or equipment manufacturers prior to placing power on the equipment.
- C. Tests may be performed by the Engineer to determine integrity of insulation on wiring circuits selected by the Engineer at random.
- D. Cost of utilities for testing done prior to beneficial occupancy by the Owner shall be borne by the Contractor.

3.10 BORING OR JACKING

- A. Boring or jacking shall be provided where indicated on the Drawings. It may be allowed at other locations with permission of the Engineer. Boring or jacking shall be performed by mechanical means and accurate vertical and horizontal alignment must be maintained. Steel cover pipe shall be used and shall be installed inside bored holes concurrently with boring or jacking. All joints shall be solidly welded. The weld shall be such that the joint shall be of such strength to withstand the forces exerted from boring and jacking operation as well as the vertical loading imposed on the pipe after installation. The weld shall also be such that it provides smooth, nonobstructing joint in the interior of the pipe. Backfill and bedding at ends of bore shall be as indicated on the Drawings. Spacers on 5' centers shall be installed to separate the conduits from the cover pipe. No greater than ½" of movement is acceptable after spacers are installed.

3.11 DEMOLITION

- A. For equipment indicated to be demolished, remove all conduit, boxes, wiring, switches, and controls associated with the equipment. Concealed conduit may be abandoned in place. All walls, floors, ceilings, and surfaces must be patched and painted to match surrounding surface after demolition is complete.

END OF SECTION

SECTION 16015
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.
- B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D. This study shall be prepared by the equipment manufacturer.
- C. Provide Arc Flash labels for all new equipment down to and including the 120/208V panelboards.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.03 SUBMITTALS FOR REVIEW/APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.04 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.
- B. The report shall include the following sections:
1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations
 2. Descriptions, purpose, basis and scope of the study
 3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings
 4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings

5. Multi-function relay setting file printouts including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.
6. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
7. Incident energy and flash protection boundary calculations
8. Comments and recommendations for system improvements, where needed
9. Executive Summary including source of information and assumptions made

1.05 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

PART 2 PRODUCT

2.01 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

2.02 DATA COLLECTION

- A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure

completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

- B. Source combination may include present and future utility supplies, motors, and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 - 5. Typical calculations
 - 6. Tabulations of calculated quantities
 - 7. Results, conclusions, and recommendations
- D. Calculate short-circuit momentary and interrupting duties for a 3-phase bolted fault at each:
 - 1. Electric utility's supply termination point
 - 2. Incoming switchgear
 - 3. Unit substation primary and secondary terminals
 - 4. Low voltage switchgear
 - 5. Motor control centers

6. Standby generators and automatic transfer switches
 7. Branch circuit panelboards
 8. Other significant locations throughout the system
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses
 3. Adequacy of transformer windings to withstand short-circuit stresses
 4. Cable and busway sizes for ability to withstand short-circuit heating
 5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.04 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the curve sheets, where applicable:
 1. Electric utility's protective device
 2. Medium voltage equipment relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

6. Conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Select each primary protective device required for a delta-wye connected transformer so that the characteristics or operating band is within the transformer parameters which includes a parameter equivalent to 58% of the ANSI withstand point to afford protection for secondary line-to-ground faults.
- H. Separate low voltage power circuit breakers from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.
- I. Engineer shall provide settings file printouts for all multifunction relays supplied under this contract including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.

2.05 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2012, Informative Annex D.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- D. The Arc-Flash Hazard Analysis shall include all MV, 480v locations, and 120/208 volt panelboards.
- E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².

- F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
- I. Specific PPE required must be identified on the Arc Flash labels.

2.06 REPORT SECTIONS

A. Input Data

- 1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
- 2. Short-circuit reactance of rotating machines with associated X/R ratios
- 3. Cable type, construction, size, # per phase, length, impedance and conduit type
- 4. Bus duct type, size, length, and impedance
- 5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
- 6. Reactor inductance and continuous ampere rating
- 7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data

- 1. Source fault impedance and generator contributions
- 2. X to R ratios
- 3. Asymmetry factors
- 4. Motor contributions
- 5. Short circuit kVA
- 6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings

1. Phase and Ground Relays
 - a. Current transformer ratio.
 - b. Current setting.
 - c. Time setting.
 - d. Instantaneous setting.
 - e. Specialty non-overcurrent device settings.
 - f. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers
 - a. Adjustable pickups and time delays (long time, short time, ground).
 - b. Adjustable time-current characteristic.
 - c. Adjustable instantaneous pickup.
 - d. Recommendations on improved trip systems, if applicable.

D. Incident Energy and Arc Flash Boundary Calculations

1. Arcing fault magnitude
2. Device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Recommendations for arc flash energy reduction

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.
- D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.02 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 in. x 4 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The label shall have an orange header with the wording, "WARNING, SHOCK AND ARC FLASH HAZARD", and shall include the following information:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Arc flash boundary
 - 4. Incident energy
 - 5. Working distance
 - 6. Shock Boundaries
 - 7. Engineering report number, revision number and issue date
 - 8. PPE Required
- C. Labels shall be machine printed, with no field markings
- D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided
 - 2. For each motor control center, one arc flash label shall be provided
 - 3. For each low voltage switchboard, one arc flash label shall be provided
 - 4. For each switchgear, one flash label shall be provided
 - 5. For medium voltage switches one arc flash label shall be provided
- E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.03 ARC FLASH TRAINING

- A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

SECTION 16060

GROUNDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Grounding shall be provided in accordance with the NEC, as described in these Specifications, and as shown on the Contract Documents.

1.02 RELATED DOCUMENTS

- A. Section 16010 – General Electrical Requirements

1.03 SUBMITTALS

- A. Submittals are required on all grounding equipment in accordance with Section 16010.

1.04 QUALITY ASSURANCE

- A. Codes and Standards
 - 1. NEC Compliance: Grounding must conform to NEC requirements.
 - 2. UL Compliance: Comply with applicable requirements of UL Standard No. 467 “Electrical Grounding and Bonding Equipment” and No. 869, “Electrical Service Equipment.” All grounding and bonding products shall be UL listed and labeled for their intended usage.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Grounding equipment shall be Cadweld, Thomas and Betts/Blackburn, Erico, Copperweld Bimetallics Group, Cathodic Engineering Equipment Co., or equal.

2.02 GROUND RODS

- A. Ground rods shall be copper-clad steel with minimum diameter of $\frac{3}{4}$ " and length of 10'. They shall conform to UL467 requirements.

2.03 GROUND CONDUCTORS

- A. Conductors shall be copper and sized as indicated on the Drawings. If size is not indicated then the conductors shall be sized according to the NEC.

2.04 GROUNDING ACCESSORIES

- A. Provide all grounding accessories necessary for a complete, functional, code-compliant grounding system. This includes but is not limited to the following: connectors, lug terminals, electrodes, bonding jumpers, surge arresters, tape, heat-shrink tubing, exothermic welding materials, bonding straps, etc.

2.05 GROUND ENHANCEMENT MATERIAL

- A. Ground enhancement material shall be GEM by Erico Products, Powerfill by Cathodic Engineering Equipment Company, or equal.
- B. The ground enhancement material must be permanent and maintenance free (no recharging with salts or chemicals which may be corrosive) and maintain its earth resistance for the life of the system. It must set up firmly and not dissolve or decompose, or otherwise pollute the soil or local water table. The material shall be capable of being applied dry or in a slurry form, and shall reduce resistance by at least 40 percent.
- C. Basic components of this material shall be carbon, hydraulic cements, and hydrous aluminum silicates. Minimum 4-inch diameter holes shall be used with ground rod installations, with depth 6" shorter than length of rod, completely filled with the material. Trenches for grounding electrode conductor shall also utilize this material the full length from electrode to building, in accordance with manufacturer installation recommendations, except trench depth shall allow buried conductor to be at least 2'-6" deep.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

- A. Grounding shall utilize a supplemental driven ground rod system in a bed to achieve the design ground resistance.
- B. The ground system shall be continuous with all structures on a common ground. This can be accomplished by bonding all conduits together and bonding to the ground bus at each distribution panel. Bonding jumpers shall be required at all pull boxes, and at all motor casings. A separate equipment grounding conductor shall be pulled in all conduits.
- C. Where multiple rods are driven, they shall be separated by at least 10 feet to assure maximum effect.

- D. Ground resistance between ground and absolute earth shall not exceed 5 ohms.
- E. All grounding and grounding electrode systems shall be as required by the NEC as for types of electrodes utilized and sizing of grounding conductor to service equipment from the electrode system. These shall include footer rebar, buried metal water pipe, buried bare copper conductor, etc.
- F. All grounding electrode system connections shall be made using exothermic welds, Cadweld, or equal. No splices are allowed in the grounding electrode conductor.
- G. Should ground rods be impractical for use due to rocky conditions, then grounding electrode plates may be used after acceptance by the Engineer on a case by case basis.

3.02 FIELD QUALITY CONTROL

A. Testing

- 1. The Contractor shall provide all labor, tools, instruments, and materials as necessary to perform testing of the grounding electrode system. Results shall be submitted in writing to the Engineer. The testing shall be done to determine the effectiveness of the selected grounding scheme and to see that it conforms with resistance specified (5 ohms maximum).
- 2. The testing should be done using a fall-of-potential method test at the point of grounding electrode conductor connection to main power distribution equipment and at each separately derived system or MCC. The test shall be performed no sooner than 48 hours after a rainfall event.
- 3. The written report should contain the following information:
 - a. Type of ground scheme used, i.e., building steel, driven rod, mat, etc.
 - b. Type of instrument used.
 - (1) Manufacturer
 - (2) Model Number
 - (3) Confirm fall-of-potential test
 - (4) *Serial Number
 - (5) *Where instrument was obtained

*These 2 items are required so that the same instrument may be utilized should reproduction of

the test be necessary due to unsatisfactory readings/instrument miscalibration.

- c. Ground resistance readings obtained at various test distances.
- d. Ground resistance/distance curve.
- e. Value of Grounding Electrode Resistance at knee of curve.
- f. Sketch showing setup of instrumentation and location of grounding electrode and test probes.
- g. Proposed method to achieve the specified resistance, should an unacceptable reading be obtained.
- h. Ground resistance readings obtained (if applicable) after modifications incorporated.

3.03 GROUND ENHANCEMENT MATERIAL

- A. Where indicated on the Drawings or as deemed necessary by the Contractor to achieve design grounding electrode system resistance, a ground enhancement material shall be utilized, in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 16070
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. All electric equipment shall be rigidly mounted and installed using supporting devices as indicated on the Contract Drawings, as required by the work, and as described herein.

1.02 RELATED WORK

- A. Section 16010 – General Electrical Requirements

1.03 SUBMITTALS

- A. Submittals are required in accordance with Section 16010 requirements.

1.04 QUALITY ASSURANCE

- A. Electrical components shall be listed and labeled by UL, ETL, CSA, or similar.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Strut: “Kindorf,” “Unistrut,” “B-Line,” “Allied Tube & Conduit,” or equal.

2.02 STRUT

- A. Epoxy-Painted: ASTM A1011 (Fittings – ASTM A1018) 33,000 psi minimum yield, coated with water-borne epoxy deposited via cathodic electro-deposition. Accessory hardware shall be ASTM B633 zinc-plated.
- B. Galvanized: Either pre-galvanized, ASTM A653 with G90 coating, or hot-dip galvanized per ASTM A123. Accessory hardware shall be ASTM B633 zinc-plated.
- C. Aluminum: Extruded alloy 6063-T6. Accessory hardware shall be stainless steel type 18-8 or 304.
- D. Stainless Steel: AISI Type 304 or 316. Accessory hardware shall be stainless steel type 18-8, 304, or 316.

2.03 HARDWARE

- A. All hardware for interior applications shall be zinc-plated.

- B. All hardware for exterior applications shall be stainless steel type 316.

PART 3 - EXECUTION

3.01 ANCHORING CABINETRY

- A. All free standing equipment shall be anchored to its foundation using expansion bolts of the size and number recommended by the equipment manufacturer.

3.02 ANCHOR METHODS

- A. Concrete: Expansion anchors, preset inserts, or purpose made anchors.
- B. Hollow Masonry: Toggle bolts or expansion anchors.
- C. Wood Surfaces: Wood screws (#10 min) or lag bolts.
- D. Metal Surfaces: Machine screws or bolts.

3.03 STRUT INSTALLATION

- A. Table of Acceptable Usage:

AREA	STRUT MATERIALS
Elec. Building Interior	Epoxy-Painted, Galvanized, Aluminum
Exterior	Aluminum, Stainless
Filter/High Service Bldg Interior	Aluminum, Stainless

- B. Epoxy-painted strut, where cut in the field, must have ends filed smooth and painted the same color as the strut.
- C. Galvanized strut, where cut in the field, must have ends filed smooth and cold galvanized.
- D. All field-cut strut shall have ends filed smooth and free of burrs or sharp edges. Any strut installed within 7 feet above finished floor must have protective foam edging applied to prevent injury to personnel.

3.04 SEISMIC CONSIDERATIONS

- A. Where indicated or specified, seismic restraints shall be provided for electrical equipment.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide electrical identification of equipment, boxes, and conductors as specified herein.

1.02 RELATED WORK

- A. Section 16010 – General Electrical Requirements

1.03 SUBMITTALS

- A. Submittals are required for electrical identification products in accordance with Section 16010 requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Brady, Safety Sign Company, Seton or equal.

2.02 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Engraved, Plastic Laminated Labels and Signs: Shall be engraved stock melamine plastic laminate, 1/16 inch minimum thickness, and shall have white plate with black letters.
- B. Vinyl self-adhesive signs: Shall warn of “High Voltage” (state the specific voltage). The type of labels to be used shall have orange as the basic color to conform with OSHA requirements, and letters shall be black. The labels shall be of proper size to fit flatly on the surface of the enclosure to make for a neat appearance and not interfere with the operating function of the device it is attached to.
- C. Colored Adhesive Marking Tape for Wires and Cables: Self-adhesive, vinyl tape not less than 3 mils thick by 1 inch in width.
- D. Conductor Labels: Shall be machine printed, heat-shrink or self-laminating type.
- E. Underground line marking tape: Permanent, red-colored, continuous printed, not less than 6 inches wide and 4 mils thick. Tape shall have metal-backing suitable for tracing.

PART 3 - EXECUTION

3.01 EQUIPMENT LABELING

- A. All starters, feeder units in panelboards, disconnects, instruments, etc. shall be marked to indicate the motor, outlet, or circuit they control. Marking is to be done with engraved laminated nameplates and shall bear the designation shown on the Contract Drawings where this information is given. Nameplates shall be fastened to equipment with stainless steel screws, minimum of one each side. In no way shall the installation of mounting screws void the NEMA enclosure rating of the equipment in which they are installed. Nameplate background color shall be white, with black engraved letters, unless otherwise noted. Typical panelboard label:

“Panel PP1
225A 480Y/277 3PH 4W
Fed From Panel MCP”

Typical Safety Switch Label:

“AHU-5
480V 3PH
Fed From Panel PP1”

Typical Instrument label:

“PIT-501
High Service Discharge Pressure”

- B. All cabinets, disconnect switches, control panels, transfer switches, panelboards etc. shall be additionally labeled with orange OSHA-compliant vinyl self-adhesive signs that list the maximum voltage contained inside the cabinet or panel.
- C. Branch circuits in lighting panels shall be typed on a card suitable for the card frame furnished with the panel. The card shall bear the panel designation listed on the Contract Drawings where this information is given, as well as indicate what each circuit controls. The Contractor shall retype new cards for all existing panelboards modified.
- D. All mechanical equipment on the project that has electrical service shall be labeled and the equipment labels must match the breaker labels. Coordinate with Divisions 2, 11, and 15.

3.02 BOX LABELING

- A. Label each box with the voltage and circuit numbers contained.

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3.03 CONDUCTOR LABELING

- A. Label each conductor to match the circuit number or manufacturer's shop drawing wiring diagrams.

3.04 ARC-FLASH HAZARD LABELING

- A. Electrical equipment shall be labeled with Arc-Flash hazard warning labels as required by the N.E.C. Labeling shall comply with ANSI Z535.4 and must list the specific PPE required for work on the electrical equipment.

3.05 AVAILABLE FAULT CURRENT AND OTHER NEC LABELING

- A. Service equipment shall be labeled with the maximum available fault current and date of calculation as required by the NEC. Contact Engineer to obtain available fault current value.
- B. Any other labels required by the NEC shall be furnished and installed by the Contractor.

END OF SECTION

SECTION 16120
CONDUCTORS, CABLES, AND CIRCUITS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide conductors, cables, and circuiting as indicated and as specified herein for a complete, functional electrical system.
- B. Building wire shall be applied based on a 75 degree Celsius temperature rise.

1.02 RELATED WORK

- A. Section 16010 - General Electrical Requirements
- B. Section 16075 - Electrical Identification

1.03 SUBMITTALS

- A. Submittals are required on all cables and conductors in accordance with Section 16010 requirements.
- B. Submittals are required on cable supports.
- C. Submit test results as specified herein.

1.04 QUALITY ASSURANCE

- A. All wire and cable shall conform to the latest requirements of the NEC and shall meet all ASTM/UL specifications. Wire and cable shall be new; shall have size, grade of insulation, voltage rating and manufacturer's name permanently marked on the outer covering at regular intervals. Complete descriptive literature shall be submitted to the Engineer for review and acceptance prior to installation.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Wire and cable shall be suitably protected from weather and damage during storage and handling and shall be in first class condition when installed.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Building Wire (type "THWN") - "Collyer," "Rome," "American," "Carol," or equal.

- B. Flexible Cords and Cables (Types "SO" (600V) "SJO" - 300V) "Collyer," "American," "Carol," or equal.
- C. Power cables, for conduit installation or direct-burial (600V, 5KV or 15 KV) - "Anaconda," "Okonite," "Triangle PWC," or equal.
- D. Control Cables (Shielded or unshielded) 600V max. - "Belden," "Eaton-Dekoron," "Okonite," or equal.
- E. Instrumentation Cables (Shielded) 600V mx. - "Eaton-Dekoron," "Manhattan," "American," "Belden," "Okonite," or equal.

2.02 GENERAL

- A. In general, all conductors shall be 98 percent conductive, annealed copper unless otherwise noted on the Contract Drawings.
- B. Conductors with high temperature rated insulations and special construction shall be used where required in connecting to light fixtures or appliances that have special requirements.

2.03 GENERAL BUILDING WIRE

- A. Conductors shall be type THWN-2 insulation. Conductor size shall be AWG (American Wire Gauge) Standard. Minimum conductor size shall be AWG number 12 except branch circuits in excess of 75 feet from panel to first outlet not smaller than no. 10 AWG. Minimum voltage rating shall be 600 volts. Conductors for small power may be solid (i.e. lighting, receptacles), but conductors for control work shall be stranded.
- B. Conductors inside control panels that do not extend outside the cabinet, shall be Type MTW with a minimum size of 18 gauge and a minimum voltage rating of 600V. Each conductor shall be terminated with a ferrule and a wire label.

2.04 INSTRUMENTATION CABLE

- A. Instrumentation cable shall have individually shielded and twisted pairs or triads. Conductors shall be tinned copper, and the cable shall include a separate drain conductor. Voltage rating shall be 600 Volt. Conductor colors shall be black and white. Shielding shall be a combination braid/foil with 100% coverage. Insulation shall be PVC or XLPE. Conductors shall be #18AWG minimum, but no smaller than the size indicated on the Drawings. Cable shall be listed for direct burial or underground duct use.
- B. All signal lines should be constructed of individually twisted pairs (6 to 10 twists per foot), including thermocouple extension leads. Cables should

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be made of twisted pairs, with all lays and pairs twisted in the same direction for maximum flexibility.

- C. Insulation resistance at 68 degrees Fahrenheit between conductors and between conductors and ground should be at least 500 megohms per 1,000 feet.
- D. Multi-pair cable should be jacketed with poly-vinyl-chloride, polyethylene or Teflon at least 0.045" thick. Voltage rating shall be 600 volts.

2.05 MULTICONDUCTOR CONTROL CABLE

- A. Shall be concentrically cabled No. 14 AWG stranded copper conductors with saturated interstitial fillers; overall binder of nylon or similar material; and PVC jacket. Quantity of conductors shall be as indicated on the Drawings, with 25% spare minimum. Conductor insulation shall be 20 mils of polyethylene with 10 mils PVC, rated 600V.
- B. Color coding shall be ICEA, Method 1.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

- A. General
 - 1. Conductors shall be continuous from outlet to outlet and no splices shall be made except accessible in junction or outlet boxes. Wire connectors of insulating material or solderless pressure connectors, properly taped, shall be used for all splices in wiring, wherever possible.
 - 2. Feeder conductors shall be color coded in accordance with the following schedule:

	<u>480/227V</u>	<u>208/240V</u>	<u>120/240, Single</u>
	<u>3 Phase</u>	<u>3 Phase</u>	<u>Phase</u>
Phase A	Brown	Black	Black
Phase B	Orange	Red	Red
Phase C	Yellow	Blue	
Neutral (Grounded)	White or Light Gray	White or Light Gray	White or Light Gray
3-Way Tracers			Blue

Grounding	Green	Green	Green
Remote Energized Control Conductors			Yellow
Standard Control			Red

3. Conductors shall be pulled into raceways in strict accordance with manufacturer's recommendations.
4. Ample slack conductors shall be allowed at each terminal point, and pull or junction box, to permit installation with ease and without crowding.
5. All conductors terminating at terminal blocks shall be identified with numbers and/or letters identical to circuit or control identification.
6. No conductors shall be drawn into conduits until all work which may cause wire or cable damage is completed. Wire pulling shall be accomplished utilizing machinery and accessories intended for the purpose.
7. All connections and splices shall be made in accordance with conductor manufacturer's recommendations, and as written herein.
8. If the size and number of conductors in a conduit on the Drawings is not shown, then it shall be assumed to be 4#12, 3/4" C.
9. All interior primary branch wiring shall be located above slabs.
10. An equipment grounding conductor, sized per NEC, shall be installed in each power, signaling, or instrumentation circuit whether indicated or not.

B. Feeders

1. Wire (up to and including #6 AWG) shall be factory color coded for each phase and neutral, with green used for the ground conductor. Larger conductors shall be identified with tape per Section 16075 requirements. As far as practical, all feeders shall be continuous from origin to panel termination without running splices in intermediate pull boxes.

C. Instrument Cable

1. Instrumentation cable must only be installed in dedicated conduits with other instrumentation cable. Installation with power conductors is prohibited.

2. Low level analog (less than 500 millivolt d-c): Use twisted pairs which may be cabled with other pairs carrying similar voltage levels. Foil wraps or equivalent shielding is required for each cable with the shield insulated from ground.
3. High level analog (greater than 500 millivolt d-c or 0-10 VDC or 4-20 mAdc): Use twisted pairs which may be cabled with other pairs carrying similar voltage levels and current levels less than 100 ma. Shielding is required.
4. All shields must be grounded at one point only as close as possible to the signal source.
5. A minimum separation of 12 inches between analog signal leads and a-c power leads should be maintained. For a-c power leads carrying 100 amps or greater, a 24 inch separation should be maintained. Parallel runs should be limited to less than 500 feet. Perpendicular runs may be as close as 6 inches.

3.02 FIELD TESTING

- A. Megohm meter testing is required on circuits with #4 and larger conductors. Prior to energizing, check with 1000V megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Minimum acceptable reading is 100 megohms held at a constant value for 15 seconds. A certified copy of megohm meter tests shall be submitted to the Engineer and included in the O&M manuals. Test results shall include ambient temperature and humidity at time of testing.

END OF SECTION

SECTION 16130

RACEWAYS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section includes all raceways for accommodation of electrical conductors, communications conductors, sleeves for underground electrical installations, conduit stubs for future installations, fittings and accessories.
- B. All raceways and fittings shall be painted to match existing or surrounding surfaces where installed exposed inside a building.

1.02 RELATED WORK

- A. Section 16010 - General Electrical Requirements
- B. Division 9 - Paint

1.03 SUBMITTALS

- A. Submit are required on all raceways and fittings in accordance with Section 16010 requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Tubular Raceways
 - 1. Steel, Galvanized, Electric-Metallic-Tubing (EMT) - "VAW," "Triangle," "Allied Tube & Conduit Corp," or equal.
 - 2. Plastic (PVC); - "Robin-Tech," "Carlon," or equal.
 - 3. Aluminum, Rigid, Heavy-Wall, Threaded - "VAW," "Alcoa," "Reynolds," or equal.
 - 4. Steel, Galvanized, Rigid, Heavy-Wall, Threaded - "Wheatland Tube Co.," "Triangle," "Allied Tube & Conduit Corp.," or equal.
 - 5. Flexible Metal Conduit - "AFC," "Alflex," or equal.
 - 6. Liquidtight Flexible Metal Conduit - "Carol Cable Co., Inc.," "Superflex," "OZ Gedney," or equal.
 - 7. Factory Coated Aluminum Conduit - Alumax "ALX-1", or equal.

B. Wireways

1. "Square-D," "Hoffman," or equal.

C. Raceway Fittings

1. Conduit fittings - "Crouse-Hinds," "Appleton," "OZ Gedney," or equal.
2. Non-metallic conduit fittings - "Robin-Tech," "Carlon," "Scepter," or equal.
3. Flexible conduit fittings - "Raco," "T & B," "OZ Gedney," or equal.

- D. All raceways shall be marked with the manufacturer's name or trademark as well as type of raceway and size. This marking shall appear at least once every 10 feet and shall be of sufficient durability to withstand the environment involved. All raceways shall be furnished and installed as outlines under Part 3 of this Specification.

2.02 MATERIALS

A. Aluminum Conduit

1. Aluminum conduit shall be extruded from alloy 6063 and shall be the rigid type, non-toxic, corrosion resistant, and non-staining. It shall be manufactured per UL standards as well as listed/labeled by same.
2. Fittings, boxes, and accessories used in conjunction with aluminum conduit shall be die cast, copper free aluminum type. They shall be resistant to both chemical and galvanic corrosion. All covers shall have neoprene gaskets.
3. Aluminum conduit proposed for concrete slab or underground applications shall be UL listed for the purpose and factory pre-coated. Corrosion-resistant taping is allowed for stubouts out of the ground.

B. Rigid Steel Conduit

1. Rigid steel conduit and fittings shall be of mild steel piping, galvanized inside and out, and shall conform to UL standards. The conduit and fittings shall be listed and labeled by UL as well. The galvanized coating of zinc shall be of uniform thickness applied by the hot-dipped process, and shall be applied also to the threads. It shall be further dipped in a chromic acid bath so as to chemically form a corrosion resistant protective coating of zinc chromate which has a characteristic yellow-green color. Each piece of conduit

shall be straight, free from blisters and other defects, cut square, and taper reamed. It shall be delivered with plastic protectors on the threads.

C. Polyvinylchloride (PVC) Conduit

1. PVC conduit and fittings shall be Schedule 80 heavy wall, as indicated in these Specifications manufactured to conform to UL standards. Schedule 40 may only be used inside concrete encasement. It shall be listed and labeled by UL. It shall have at least the same temperature rating as the conductor insulation. Expansion joints shall be used as recommended by the manufacturer in published literature. PVC systems shall be 90 degrees Celsius minimum UL rated, have a tensile strength of 7,000 psi @ 73.4 degrees Fahrenheit, flexural strength of 11,000 psi and compressive strength of 8,000 psi.
2. PVC conduit support clamps shall be non-metallic, non-corroding and specially designed for expansion and contraction. Adapters shall be provided for use with strut. Provide IPEX Scepter or equal.

D. Electrical Metallic Tubing (EMT)

1. EMT shall be high grade steel with an exterior galvanized coating of zinc applied uniformly by the electro-galvanized process. The interior surface shall be uniformly coated with aluminum lacquer or enamel. After galvanizing, it shall be dipped in a chromic acid bath to chemically form a protective coating of zinc chromate. The conduit shall conform to UL standards and be listed as well as labeled by UL.

E. Flexible Conduit

1. Flexible metallic conduit shall be constructed from flexibly or spirally wound electro-galvanized steel. Connections shall be by means of galvanized malleable iron squeeze type fittings, or tomic twist-in type in sizes not exceeding 3/4 inch. Liquidtight conduit shall be light gray in color and have sealtight fittings, type UA. It shall be sunlight resistant and suitable for minimum temperature range of -22°F to 140°F. Where aluminum conduit is required below, the liquidtight fittings shall be constructed of copper-free aluminum. Where PVC conduit is required below, the liquid-tight shall be type NMUA non-metallic with non-metallic fittings.

F. Conduit Fittings

1. Rigid Steel Conduit Fittings
 - a. Standard threaded couplings, locknuts, bushings, and elbows made only of steel or malleable iron are acceptable.

- b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
- c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
- d. Erickson (union-type) couplings: Approved for use in concrete are permitted or use to complete a conduit run where conduit is installed in concrete.
- e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, installed fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.
- f. Compression fittings are NOT acceptable for use with Rigid conduit. All connections are required to be threaded.

2. Rigid Aluminum Conduit Fittings

- a. Standard threaded locknuts and bushings shall be malleable iron, zinc-plated steel or aluminum alloy materials. Bushings/hubs shall have insulated throats. Elbows, couplings, hubs, and connectors shall be aluminum. Aluminum fittings containing more than 0.4 percent copper are prohibited.
- b. Set screw or compression fittings: Not permitted for use with aluminum conduit.

3. Electrical Metallic Tubing Fittings

- a. Only material of steel or malleable iron is acceptable.
- b. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for all conduit sizes.
- c. Set screw indent type connectors or couplings are prohibited.
- d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

- 4. Expansion and Deflection Couplings
 - a. Accommodate 1.9 cm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - b. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL, and the NEC code tables for ground conductors.
 - c. Watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material and stainless steel jacket clamps.
- G. Corrosion-Protection Tape: The corrosion protection tape shall be Scotchrap 51 or equal with 20mil thickness PVC tape and high-tack adhesive. Degreasing and priming of the conduit is required prior to applying the corrosion-protection tape.
- H. Duct Seal: Sealant shall be UL-listed electrical duct seal, Gardner Bender #1003 or equal. Caulk is not acceptable. Sealant shall be asbestos-free, permanently soft/non-hardening, FDA/USDA approved non-toxic, non-corrosive, non-irritant, and paintable. Temperature range shall be -30°F to 175°F, minimum.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Underground metallic conduits shall be degreased, primed, and wrapped with all-weather corrosion-resistant tape to 6" above finished grade. The tape shall be 50% overlapped such that there is an effective 2-layers of tape protecting the conduit.

3.02 INSTALLATION

- A. Conduit
 - 1. Conduit shall not be installed in wall cavities between face brick and block. The only time this will be allowed is for serving an exterior receptacle or light fixture.
 - 2. Underground raceways (conduit) shall be provided with steel sleeves where they pass over or under obstructions, such as: sidewalks; roadways; piping; etc.

3. All conduit shall have an insulated ground wire pulled to all equipment and receptacles.
4. All raceway runs are shown diagrammatically to outline the general routing of the raceway. The installation shall be made to avoid interference with pipes, ducts, structural members or other equipment. Should structural or other interference prevent the installation of the raceways, or setting of boxes, cabinets, or the electrical equipment, as indicated in the Drawings, deviations must be approved by the Engineer, and after approval, shall be made without additional charges and shown on the Record Drawings.
5. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases, with UL listed sealants only. Completely fill and seal clearances between raceways and openings with the fire stop material.
6. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
7. No conduit shall be run exposed across roofs.
8. Conduit shall not be run horizontally inside concrete slabs.
9. No conduit shall be run exposed across floors.
10. Electrical conduits and/or equipment shall be rigidly supported. Anchors used shall be metallic expansion type, or if appropriate to prevent spalling concrete, epoxy set type.
11. Contractor shall provide all necessary supports in accordance with KBC Seismic requirements.
12. All conduit shall be installed in a first class workmanship manner. It shall be installed in horizontal and vertical runs in such a manner as to ensure against trouble from the collection of trapped condensation and shall be arranged so as to be devoid of traps wherever possible. Special care shall be used in assuring that exposed conduit runs are parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. No open wiring is allowed.
13. Fittings or symmetrical bends shall be required wherever right angle turns are made in exposed work. Bends and offsets shall be avoided wherever possible, but where necessary, they shall be made with an approved conduit bending machine. All conduit joints shall be cut square, reamed smooth and drawn up tight, using couplings intended for the purpose.

14. Conduits shall be securely fastened to all sheet metal outlets, junction and pull boxes with double galvanized locknuts and insulating-grounding bushings as required by the NEC, except for penetrations in NEMA 4/4X areas which shall utilize Myers sealing hubs. Runs of exposed conduit shall be supported in accordance with the NEC using cast aluminum or malleable iron one hole pipe straps with clamp-back spacers to provide an air space behind the conduit. Stainless steel minerallac, one piece conduit clamps shall be acceptable where located such that building occupants are not in danger of inadvertent contact, since this type fitting has several sharp edges. In general terms, they may be considered in areas such as on or above ceilings, or high on walls. All conduit in walls and slabs shall be securely braced, capped (wooden plugs are prohibited), and fastened to the forms to prevent dislodgement during vibration and pouring of concrete.
15. During construction, all conduit work shall be protected to prevent lodgement of dirt, plaster or trash in conduits, fittings or boxes. Conduits which have been plugged shall be entirely freed of accumulations or be replaced. All conduits in floors or below grade shall be swabbed free of debris and moisture before wires are pulled. Crushed or deformed conduit shall not be permitted.
16. All open conduit work through floor slabs shall be made watertight by grouting around conduit. Provide coating where conduit comes in contact with all concrete.
17. Where metallic conduit penetrates a floor slab the conduit shall be taped with corrosion protective tape.
18. The final section of conduit connecting each motor or piece of utilization equipment subject to vibration shall be of the flexible type. Type "UA" shall be used in all process areas and in outdoor or wet locations. Flexible conduit to space heaters shall be long enough to allow swivel action.
19. All underground conduits entering a building shall be sealed against water/condensate entering around the conductors with duct seal.
20. In certain situations, conduit expansion joints shall be required to ensure against conduit and/or cable damage due to settling or thermal expansion and contraction. These expansion joints shall be required where required by the manufacturer or the Contract Drawings and shall be installed per manufacturer's instructions.
21. Motor control centers, meter panels, computer panels, switchgear, etc., mounted in a building with a basement or pipe gallery below, shall have the conduit opening left in the slab sealed to prevent

moisture, dust, etc., from entering the panel. The type of seal to be used shall be silicone elastomer foam, as manufactured by Dow-Corning, Chase-foam as manufactured by Chase Technology Corporation, T & B, or equal.

22. Conduits entering from underground into buildings shall be watertight through the wall, both inside and outside.
23. Where PVC conduit is installed, underground transition shall be made to metallic conduit at bends where wire pulling could cut conduit.
24. Aluminum conduit shall not be used underground, in chemical or chlorine storage/feed areas, or placed in concrete slabs, unless it is UL listed for the purpose and factory pre-coated.
25. Conduit stubs, for future use, extended through outside walls shall be capped with threaded pipe caps and taped to prevent corrosion. Stubs shall extend 5 feet beyond the walls from which they are stubbed unless otherwise indicated on the Contract Drawings.
26. All metal raceway systems shall be grounding conductive, solidly bonded throughout and grounded in accordance with NEC requirements and/or as noted on the Contract Drawings. In addition, all raceway systems shall be provided with separate grounding conductors.
27. Minimum conduit size shall be 3/4 inch.
28. The minimum burial depth for any conduit shall be 30".
29. Wire pulling shall be facilitated by the use of a UL approved pulling compound in pulls over 30 feet in length or where there are 2 or more 90 degree bends. Only polypropylene, nylon, or manila pulling ropes will be permitted. Standard industry recognized wire pulling equipment shall be used.
30. All conduits entering and leaving exterior enclosures shall be sealed around the wires with duct seal. All underground conduits or exterior conduits shall be sealed with duct seal where they penetrate into an interior enclosure.

31. Areas of use for each type of conduit:

	PVC	EMT	GRS	Aluminum
Exterior Below 600V				
Underground	X		X	
Exposed				X
Filter & Old High Service Bldg - Interior				
Interior Exposed				X
Interior Concealed		X	X	X
Electrical Building - Interior				
Under Floor Slab	X		X	
Interior Exposed		X	X	X
Interior Concealed		X	X	X
Medium Voltage				
Underground	X		X	
Exposed				X

END OF SECTION

SECTION 16131

BOXES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Outlet/device boxes, pull boxes, junction boxes, and underground boxes shall be furnished and installed where indicated on the Contract Drawings, and\or as required by the work in accordance with the NEC.
- B. Manholes shall be provided where indicated.

1.02 RELATED WORK

- A. Section16010 - General Electrical Requirements

1.03 SUBMITTALS

- A. Submittals are required on all boxes and cabinets in accordance with Section 16010 requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Boxes - "Wiegmann," "Appleton," "Raco," "Crouse-Hinds," "Hoffman," "Robroy Industries," "Cloud Concrete Products," "Carlson," or equal.
- B. Cabinets - "Hoffman," "Wiegmann," "Rittal," or equal.

2.02 GENERAL

- A. Outlet/Device Boxes:
 - 1. Exposed Steel Conduit: Provide cast or malleable iron, zinc-electroplated outlet boxes finished with aluminum lacquer or enamel. Provide cast metal covers with neoprene gaskets for NEMA 4 areas and stamped steel covers for NEMA 12 and undesignated areas.
 - 2. Exposed Aluminum Conduit: Provide copper free, cast aluminum boxes. Hardware shall be stainless steel.
 - 3. Concealed Conduit: Provide galvanized coated flat-rolled sheet steel outlet wiring boxes of dimensions required by NEC. Boxes shall be flush mounted.

4. Exceptions to the above shall include NEMA 4X areas, where stainless type 316 boxes are required.
- B. Junction and Pull Boxes
1. Exposed Steel Conduit, up to 50 cubic inches: Provide cast or malleable iron, zinc-electroplated outlet boxes finished with aluminum lacquer or enamel. Boxes shall have drilled external, cast mounting extensions (bossed to provide at least 1/8" between back of box and mounting surface for drainage). Provide cast covers with neoprene gaskets.
 2. Exposed aluminum conduit, up to 50 cubic inches: Provide copper free, cast aluminum boxes. Hardware shall be stainless steel.
 3. Exposed Conduit, Larger than 50 cubic inches: Provide sheet metal boxes with hinged covers and appropriate gaskets and NEMA rating. NEMA 1 and 12 areas shall be painted steel or aluminum. NEMA 4X areas shall be stainless type 316.
- C. Underground junction or pull boxes or handholes shall be constructed of reinforced concrete cast-in-place or pre-fabricated as detailed on the Contract Drawings. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48/A 48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

PART 3 - EXECUTION

3.01 INSTALLATION, APPLICATION, AND ERECTION

- A. General
1. Boxes shall be installed in the locations shown on the Contract Drawings. The Contractor shall study the general building plans in relation to the space surrounding each outlet, in order that his work may fit the other work required by these Specifications. When necessary, the Contractor shall relocate devices so that when fixtures or other fittings are installed, they will be symmetrically

located according to room layout and will not interfere with other work or equipment.

2. All supports for outlet boxes shall be furnished and installed by the electrical trades.

B. Concealed Work

1. All outlet boxes inside CMU walls shall be 4" x 4" standard galvanized steel type at least 1½ inches deep. Exceptions shall be noted on the Contract Drawings. Provide two inch single plaster ring for single devices in all CMU walls.
2. Standard deep type outlet boxes (concrete rings with appropriate covers) shall be used in floor slab construction so concealed conduits entering sides of boxes can clear reinforcing rods.
3. Outlet boxes for concealed telephone and signaling systems shall be the 4-inch square type, unless otherwise noted or required by the telephone company.
4. See details on Drawings for box requirements.

C. Interior Pull and Junction Boxes

1. Interior pull and junction boxes are not shown but shall be used as needed.

D. Manholes and Pullboxes - Exterior Underground

1. General
 - a. Manholes and pull boxes for exterior underground work are shown on the Contract Drawings and are the minimum number required. Others may be added at the Contractor's option, but no extra pay shall be allowed. See detail on the Contract Drawings.
 - b. Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of manholes that are not indicated on the drawings shall be approved by the Engineer prior to construction. Manholes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes

having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and pullbox entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a Portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

2. Electric Manholes

- a. Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3. Pullboxes

- a. Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage," "Communications," or "Instrumentation" as applicable and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

4. Ground Rods

- a. A ground rod shall be installed at the manholes and pullboxes. Ground rods shall be driven into the earth before

the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

E. Openings in Electrical Boxes

1. All openings in electrical equipment, enclosures, cabinets, outlet and junction boxes shall be by means of welded bosses, standard knockouts, or shall be sawed, drilled, or punched with tools specially made for the purpose. The use of a cutting torch is prohibited. Unused openings shall be plugged per the NEC.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Wiring devices shall be provided where indicated on the Contract Drawings.

1.02 RELATED WORK

- A. Section 16010 – General Electrical Requirements
- B. Section 16130 - Boxes

1.03 SUBMITTALS

- A. Submittals are required on all wiring devices in accordance with Section 16010.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. “Hubbell,” “Bryant,” “Eagle,” “General Electric,” “Wiremold,” “P&S,” “Leviton,” “Daniel Woodhead,” or equal.

2.02 EQUIPMENT

- A. Wiring Device Color: Grey
- B. Receptacles
 1. General – All receptacles shall be heavy duty specification grade duplex receptacle, NEMA 5-20R, 20A, 125V, 3-wire. Provide weatherproof-in-use cover where indicated on the Drawings. Duplex outlet (interior) - “Hubbell” catalog series 5362, or equal.
 2. Single outlet – Hubbell series 5361 single receptacle, or equal.
 3. Special purpose outlet - Per equipment requirements.
 4. Ground fault interrupting receptacles shall be required where shown on the Contract Drawings, and shall be indicated by the abbreviation “GFI” beside the circuit symbol on the Contract Drawings. They shall be rated 20 amps (125 volts) and shall be of the duplex, feed through type, capable of protecting all downstream receptacles on the same circuit. They shall be UL

listed and shall comply with UL 943 and interrupt the current between 4-6 milliamps of ground fault leakage. Appropriate plates shall be furnished and installed. The 20 ampere rating shall apply not only to device internals but to the faceplate as well. Receptacle shall be Hubbell GFI 5352, or equal.

C. Plates and Covers

1. Furnish and install plates of the appropriate type and size for all wiring and control devices, signal and telephone outlets.
2. All plates on surface mounted boxes shall be of 302 stainless steel (nonmagnetic) with rounded or beveled edges, except in exterior locations, then weatherproof-in-use covers shall be installed. All plates on flush mounted boxes shall be 302 stainless steel. All device plate screws shall be stainless steel with countersunk heads. Screwheads shall be colored to match the plates. Plates shall be installed vertically and with an alignment tolerance of 1/16 inch. Device plates shall be of the one-piece type, of suitable shape for the devices to be covered. Plates shall have a smooth finish with no crevices to collect dirt. Oversize plates are not acceptable.
3. Covers for boxes serving equipment where flexible conduit is to be tapped into cover plates shall be sheet metal drilled for conduit. Gaskets shall be required as well as all special adapters for mounting.
4. Weatherproof covers shall be Hubbell WP series, Thomas and Betts 2CKG, or equal. They shall be weatherproof-in-use with cast aluminum construction. Mounting screws shall be stainless. Protection shall be NEMA 3R.

D. Wall Switches (Tumbler Type)

1. General - Switches shall be industrial grades, 120/277VAC, 20A Single pole - "Hubbell" cat. series 1221, or equal.
2. Single pole (exterior) - "Hubbell" cat. no. 1222-gray, or equal, and Bryant 7420 or equal plate.
3. 3-way switches (interior) - "Hubbell" cat. no. 1223, or equal.
4. Weatherproof switch covers shall be Hubbell 7420 series, or equal, with stainless mounting screws, cast aluminum construction and wet location rating.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. Wall Switches

1. Wall switches shall be mounted at a height as indicated on the Drawings, unless otherwise noted on the Contract Drawings.

B. Receptacles

1. Outlets shall be located as shown on the Contract Drawings. Where located in special interior finishes, they shall be properly centered. Boxes shall be of the type noted and accepted for the specific installation.
2. Furnish and install receptacle circuits where called for on the Contract Drawings and/or by these Specifications. Circuits shall be installed in conduit from panel to receptacle, with flush mounted boxes except as noted on the Contract Drawings.
3. Receptacles and lighting circuits shall not be combined on the same overcurrent device. For runs over 75 feet or for 30 amp receptacles, minimum wire size shall be AWG No. 10.
4. Receptacles for specific devices shall be rated at the correct voltage and amperage for that device.
5. The minimum free length of conductor at each box for the connection of a fixture, switch or receptacle shall be 8 inches. All connections shall be made mechanically and electrically secure.
6. Mounting heights shall be as indicated on the Drawings.
7. All receptacles shall be mounted with the grounding slot above the neutral and hot.

END OF SECTION

SECTION 16150

WIRE CONNECTIONS AND CONNECTING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Wire connection and connecting devices shall be as herein specified.

1.02 RELATED WORK

- A. Section 16010 - General Electrical Requirements

1.03 SUBMITTALS

- A. Submittals are required in accordance with Section 16010.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Connectors, Lugs, etc. - "T & B", "Anderson", "Burndy", or equal.
- B. Ties and Servings - "T & B", "Panduit", or equal.
- C. Termination and splice connectors - "3M Scotchlok", "Anderson", "T & B", "Burndy", or equal.

2.02 MATERIALS

- A. Wire Splicing and Terminations (600 Volts and Below)
 - 1. Electrical Terminal and Splice Connectors (#22 - #4 AWG)
 - a. Terminals and splice connectors from #22 - #4 AWG shall be compression types with barrels to provide maximum conductor contact and tensile strength. Performance, construction, and materials shall be in conformance with UL standards for wire connectors and rated for 600 volts and 105 degrees Celsius.
 - b. Connectors shall be manufactured from high conductivity copper and entirely tin plated. Terminal barrels shall be serrated on the inside surface and have a chamfered conductor entry. Terminals shall have funnel entry construction to prevent strand fold-back. All barrels shall be brazed seam or seamless construction.

- c. Spade type terminals shall be sized for the appropriate stud and shall be locking type that snap firmly onto studs with a close fit for maximum retention. Spade type terminals shall be insulated with an insulation suitable for maintaining a high dielectric strength when crimped and be made from nylon, PVC, or equal.
- 2. Electrical Lugs and Connectors (#6 AWG - 1000 Kcmil)
 - a. Lugs and splice connectors from #6 AWG - 1000 Kcmil shall be compression types with barrels to provide maximum conductor contact and tensile strength. They shall be manufactured from high conductivity copper and entirely tin plated. They shall be crimped with standard industry tooling. The lugs and connectors must have a current carrying capacity equal to the conductors for which they are rated and must also meet all UL requirements. All lugs above 4/0 AWG shall be 2 hole lugs with NEMA spacing. The lugs shall be rated for operation through 35 KV. The lugs shall be of closed end construction to exclude moisture migration into the cable conductor.
- 3. Twist-on Wire Connectors (#22 AWG - #10 AWG)
 - a. All twist-on wire connectors must have a corrosion resistant spring that is free to expand within a steel jacket. The steel jacket must be insulated with a flexible vinyl jacket capable of withstanding 105 degrees Celsius ambient temperatures and of sufficient length to cover wires that are inadvertently overstripped.
 - b. Each connector size must be listed by UL for the intended purpose and color coded to assure that the proper size is used on the wire combinations to be spliced. The connectors must be compatible with all common rubber and thermoplastic wire insulations.
- 4. Solderless/re-usable lugs shall be used only when furnished with equipment such as control panels, furnished by others, where specification of compression type lugs is beyond the Contractor's control. In the event their use is necessary, the Contractor shall be responsible for assuring that they are manufactured to NEMA standards, with proper number and spacing of holes and set screws.

PART 3 - EXECUTION

3.01 INSTALLATION, APPLICATION, & ERECTION

A. Insulation of Splices and Connections

1. Connections/splices with a smooth even contour shall be insulated with a conformable 7 mil thick vinyl plastic insulating tape which can be applied under all weather conditions and is designed to perform in a continuous temperature environment up to 105 degrees Celsius. The tape shall have excellent resistance to abrasion, moisture, alkalis, acids, corrosion, and varying weather conditions (including sunlight). The tape shall be equal to Scotch 33+ and shall be applied in conformance with manufacturer's recommendations. In addition, it shall be applied in successive half-lapped layers with sufficient tension to reduce its width to 5/8 of its original width. The last inch of the wrap shall not be stretched.
2. Connections/splices with irregular shapes or sharp edges protruding shall be first wrapped with 30 mil rubber tape to smooth the contour of the joint before being insulated with 33+ insulating tape specified in the previous paragraph. The rubber tape shall be high voltage (69 KV) corona-resistant based on self-fusing ethylene propylene rubber and be capable of operation at 130 degrees Celsius under emergency conditions. The tape must be capable of being applied in either the stretched or unstretched condition without any loss in either physical or electrical properties. The tape must not split, crack, slip, or flag when exposed to various environments. The tape must be compatible with all synthetic cable insulations. The tape must have a dissipation factor of less than 5 percent at 130 degrees Celsius, be non-vulcanizing, and have a shelf life of at least 5 years. The rubber tape shall be applied in successive, half-lapped wound layers and shall be highly elongated to eliminate voids. Other manufacturer's recommendations on installation shall be adhered to. The rubber tape shall be equal to Scotch 23 or 130C electrical splicing tape.
3. Splices made in wet or damp locations shall be made submersible and watertight with special kits made for the application and compatible with type of cables employed.

B. Connection Make-up

1. Connections of lugs to bus bars, etc., shall be made up with corrosion resistant steel bolts having non-magnetic properties with matching nuts, and shall utilize a Belleville spring washer (stainless steel) to maintain connection integrity. Connections shall be torqued to the proper limits. Prior to bolting up the connection,

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electrical joint compound shall be brushed on the contact faces of the electrical joint.

END OF SECTION

SECTION 16230

STANDBY POWER GENERATOR SYSTEM

PART 1- GENERAL

1.01 SCOPE OF WORK

- A. This Specification covers the installation of a fixed emergency standby generator system and its major items of auxiliary equipment.

1.02 RELATED WORK

- A. Section 16010 – General Electrical Requirements
- B. Section 16496 – Automatic Transfer Switch

1.03 SUBMITTALS

- A. The submittal shall include complete shop drawings and specification data on the generator system. Submit in accordance with Section 16010 requirements.
- B. The submittal shall include complete wiring schematics and interconnection diagrams identifying by terminal number each required interconnection between the transfer switch, emergency shutoff pushbuttons, engine control panel, etc. The submittal shall also contain complete descriptive literature on every piece of equipment, battery-sizing calculations, and spare parts list.
- C. The submittal shall include complete installation, startup, operation, and maintenance instructions.
- D. Exceptions to this specification shall be clearly indicated in the submittal.
- E. The submittal shall include all factory test results for testing required under this specification.
- F. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted.
- G. Test reports are required for each phase of testing required below.

1.04 QUALITY ASSURANCE

- A. The engine, generator, and all equipment that make up the standby generator systems shall be bid direct to each Contractor by the manufacturer or his authorized distributor maintaining a parts and service facility within 150 miles of the project location.

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- B. All materials equipment and parts comprising the units specified herein shall be new and unused, of current manufacture and of the highest grade. All equipment shall be free from all defects or imperfections.

1.05 GUARANTEE

- A. Equipment furnished under this section shall be guaranteed against defective parts or workmanship for a period of 2 years or 1000 hours (whichever comes first) from the date of field-testing and acceptance by the Owner. This warranty shall include all expenses that will normally be incurred if a service technician must visit the site to troubleshoot and/or repair a defective generator system.
- B. Under the bid alternate in the Form of Proposal, submit an option for a 5-year warranty.

1.06 REFERENCE STANDARDS

The generator covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with current editions of the following standards:

- A. NFPA 1 – Fire Code
- B. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance with Article 700, 701, and 702.
- C. NFPA110 - Emergency and Standby Power Systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit; component level type tests will not substitute for this requirement.
- D. UL508A. The entire control system of the generator set shall be UL508A Listed and labeled.
- E. UL2200. The generator set shall be UL2200 Listed
- F. NFPA 37 “Stationary Combustion Engines and Gas Turbines”
- G. NFPA 30 “Flammable and Combustible Liquids Code”
- H. EPA – Generator engines shall be certified to the latest applicable regulations issued by the EPA regarding emissions compliance.

1.07 TESTING

- A. The generator sets shall be completely factory tested at the engine plant in accordance with NFPA 110 requirements.

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- B. The assembled generator set with enclosure shall be factory tested at the assembly plant to ensure proper operation.
- C. Prior to acceptance of the installation, the equipment shall be tested to show it will perform satisfactorily, including automatic starting, subject to full load test or as much of full load as is available at the plant, shutdown, and reset as required in these Specifications. Prior to acceptance, the Contractor shall correct any defects that become evident during this test.

1.08 START-UP

A. Generator Set

On completion of the installation, the initial startup shall be performed by a factory-trained representative of the engine supplier. At the time of startup, operating instruction and maintenance procedures shall be thoroughly explained to operating personnel. Installation, operating, and maintenance instruction books shall be submitted for each electric set and all auxiliary equipment in a 3-ring binder, at the time of submittal of descriptive literature, for review. The manufacturer's service representative shall be prepared to check phase rotation "by instrument", prior to start-up. It will not be allowed to isolate one motor on the generator and check its rotation to determine phasing.

B. Automatic Transfer Switch

After the installation is completed, the transfer switch shall be tested by simulating a power failure and having each unit automatically start, come up to speed, and assume the available load at the site. The alarm and shutdown features of each set shall be tested to make sure they are in proper working order. Any defects that become evident at this time shall be corrected before acceptance of the complete standby generating system by the Owner. The supplier shall specify the nearest location where parts and service will be available.

1.09 PERMITTING

- A. Contractor is required to obtain a fuel tank permit in accordance with State law and have the installation inspected by a certified inspector. Fees for this shall be included in the Contractor's bid price.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Base bid generator shall be manufactured by "Caterpillar". "Cummins", "Kohler", or "Generac" are acceptable alternates.

2.02 GENERATOR SET

- A. Generator Rating: See the generator specifications in the One-Line Diagram on the Contract Drawings.
- B. Rating
 - 1. Each standby emergency generator shall be rated for standby service with normally varying loads during interruption of utility power, 0.8 power factor, 3 phase 4 wire, 60 Hz, and shall have a maximum operating speed of 1,800 rpm. The maximum ambient temperature outside of the genset enclosure will be 104°F. The minimum ambient temperature outside of the genset enclosure will be -20°F.
 - 2. Ratings must be substantiated with manufacturer's standard published curves. Special ratings for a particular application are not permitted. These ratings must reflect the net power available after deducting all engine driven accessories.
- C. Engine
 - 1. The engine shall be capable of operating under full load at 1,800 rpm maximum and shall be full compression diesel type and of the 4-stroke cycle, fuel injected, water-cooled. Standby output shall not be less than as required to obtain the above power ratings at a governed speed of 1,800 rpm with fan. The engine shall have a minimum displacement of 76 Liters and a maximum allowable brake mean effective pressure (BMEP) of 344 PSI.
 - 2. Engines shall be capable of normal operation on commercial grade No. 2 diesel fuel. Each unit shall be furnished with filters for fuel, oil, and intake air. A suitable lubrication oil cooler and transfer pump shall be furnished as part of the engine equipment. The engine manufacturer shall furnish lubricating oil for each unit.
 - 3. Each engine shall have an engine-mounted radiator of sufficient capacity to maintain safe operating temperature at 109°F. The engine shall be equipped with thermostats and a jacket water pump of sufficient capacity to meet this requirement. The radiator shall be equipped with a core guard, fan guard, and flange for duct connection. Flexible hose connections shall be provided at the engine and radiator. Each radiator and engine cooling system shall be filled with a 50 percent solution of anti-freeze and water to prevent freezing. The generator set supplier shall provide antifreeze prior to start-up.
 - 4. A critical type silencer shall be furnished for each unit. A stainless steel flexible exhaust fitting shall be provided for mounting between the engine exhaust and exhaust pipe. The silencer

system shall be of a type and size to ensure against loss of engine power due to excessive backpressure. The silencer shall be equipped with a condensate drain. A bird screen shall be welded into the exterior end of the exhaust pipe. Rain-caps shall be provided where there is possibility of rain entering the pipe.

5. Safety shutoff alarms shall be provided for high water temperature, low oil pressure, engine overspeed, engine overcrank, and high lubricating oil temperature.
6. The engine assembly shall be mounted on a structural steel subbase and shall be provided with vibration isolators between the engine and the steel subbase or between the base and floor.
7. The engine shall be equipped with an engine mounted thermal circulation type water heater to maintain engine jacket water at 90 degrees Fahrenheit in an ambient temperature of 30 degrees Fahrenheit. The heaters shall be designed for 208 volt AC power supply. Provide three-phase heaters if available.
8. Each unit shall be equipped with an isochronous electronic governor. The adjustment shall be accessible. The governor shall provide frequency regulation at steady state to within $\pm 0.25\%$.

D. Generator

1. The generator shall be oversized as necessary to accommodate the large motors on this project and shall be built to NEMA MG 1 standards.
2. Generators shall be two-bearing form wound, 3 phase, 60 Hz., 0.8 power factor, synchronous type, NEMA Class H insulation vacuum impregnated with epoxy varnish for fungus resistance, and directly connected to the engine flywheel housing with a flex coupling. Temperature rise of the rotor and stator shall not exceed 105°C (maximum) at the standby power rating in a 40 degrees Celsius ambient. Alternator shall provide a minimum 6,128 skva at 30% voltage dip and 0.4 power factor.
3. Generators shall have permanent magnet exciters, which shall derive excitation current from a pilot exciter, mounted on the rotor shaft. It shall enable the alternator to sustain 300% of rated current for ten seconds during a fault condition.
4. Generators shall have an automatic voltage regulator to provide voltage regulation over the engine load range to within ± 0.5 percent of rating for constant loads. The regulator shall include electronic voltage buildup, volts per Hertz regulation, three phase sensing, over-excitation protection, loss of sensing protection,

temperature compensation, voltage limit on startup, and shall be environmentally sealed.

5. The generator shall include anti-condensation winding heaters of the same voltage as the water jacket heater.
6. Current transformers shall be provided suitable for integration with the transfer switch controller and shall be installed on the conductors exiting the generator. The CT/controller system shall shutdown the genset upon sensing overcurrent conditions, in sufficient time to protect the alternator and conductors from damage.

E. Engine Generator Controls

1. Provide for each generator a control panel incorporating complete controls for all functions of the electric set and associated mechanisms. The panel shall be generator mounted with dead front and protected from the weather inside the enclosure. Each panel shall contain as a minimum the following:
 - a. Power meter (volts, amps, frequency, power, KVA, KVAR, power factor. Provide measurements for each phase and average values.)
 - b. Engine oil pressure
 - c. Coolant temperature
 - d. Engine RPM
 - e. System DC volts
 - f. Engine Running Hours
 - g. Automatic starting controls as specified herein
 - h. Automatic voltage regulator
2. Fully automatic engine start-stop controls shall be furnished in each generator control panel. Provide a 3-position selector switch marked, "Auto", "Manual", "Off"; battery charger disconnect contacts; and 2 programmable auxiliary contacts, normally open; and 2 programmable contacts normally closed.
3. The generator set shall be furnished with an emergency shutoff switch prewired and installed just inside the entrance of the enclosure.
4. Provide the following additional indicators for protection and diagnostics according to NFPA Level 1:
 - a. Low Oil Pressure
 - b. High Water Temperature
 - c. Low Coolant Level
 - d. Overspeed
 - e. Overcrank (with lockout)

- f. Emergency Stop Depressed
- g. Approaching High Coolant temperature
- h. Approaching Low Oil Pressure
- i. Low Coolant temperature
- j. Low voltage in battery
- k. Control switch not in auto. Position
- l. Low fuel main tank
- m. Battery charger AC failure
- n. High Battery voltage
- o. EPS supplying load
- p. Spare

F. Automatic Starting System

1. Provide a dual-motor DC electric starting system for each unit with positive engagement.
2. Provide a lead-acid storage battery set with battery service safety kit and cell covers, for each unit, of the heavy-duty diesel starting type. Battery voltage shall be compatible with the starting systems. Batteries shall be of sufficient capacity to provide full cranking power for 1-1/2 minutes cranking time without recharging at a battery and engine temperature of 32 degrees Fahrenheit (assume SAE 30 oil for calculation purposes). Supply battery racks, warming pads and all necessary cables. The battery warming pads shall be wired to a common cord with the jacket water heater for connection by the Contractor.
3. The battery charger to be furnished for each unit shall employ transistor controlled magnetic amplifier circuit to provide continuous taper charging. Each charger shall maintain rated output voltage with a-c line fluctuations of +/- 10 percent. Each charger shall be equipped with full wave rectifiers, automatic surge suppressors, automatic a-c line compensation, automatic overload protection, d-c ammeter and voltmeter, fused a-c input and d-c output. Each charger shall be equipped with a timer to automatically equalize charge every 30 days for 24 hours. Input voltage shall be 120 volts, 60 Hz., a-c. The charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, and high DC volts. Amperage output shall be no less than ten (10) amperes.

G. Resistance Grounding System

1. Provide a high-voltage, low-resistance type Neutral Grounding Resistor (NGR) for installation outdoors onto a concrete pad. See the required ratings of the NGR on the One-Line Diagram in the Contract Drawings.

2. The NGR shall be designed, manufactured and tested as per the latest revisions of IEEE-32.
3. The resistive elements shall be low temperature coefficient, resistor grade stainless steel of sufficient mass to withstand the rated current and prescribed duty.
4. The resistors shall be mounted in corrosion resistant support frames, using stainless-steel hardware.
5. The entire resistor assembly shall be mounted on insulators rated for the system voltage.
6. All resistor terminals and interconnections between resistor units shall be stainless-steel using stainless- steel hardware including lock washers. High current connections shall be spot or TIG welded as appropriate.
7. Connections between resistors and bushings or current transformers shall be solid copper or stainless steel bus or copper cables.
8. The frame of the enclosure shall be made from structural steel angles welded together, or bolted together with stainless-steel hardware. The top of the enclosure shall be solid, slightly overhung and sloped. It shall be embossed with stiffening ribs. The enclosure shall have forged eyebolts in each corner for lifting purposes.
9. The bottom of the enclosure shall be screened with expanded or perforated metal with openings of 1/2" or less. This screening shall be welded or bolted in and is not removable. It shall be elevated 4 to 6 inches above the base of the unit.
10. Bolt-on side covers on all four sides shall be used. Screened covers may be furnished for certain applications. Stainless-steel hardware shall be used. Louvered or screened openings shall not exceed 1/2".
11. A durable nameplate, permanently attached to one side cover shall show the manufacturer and the complete rating.
12. The enclosure shall be suitably cleaned, primed and painted to a color matching the generator enclosure. Enclosures shall be protected from scratching during manufacture, assembly and shipment.

H. Weatherproof Housing

1. Walk-in Enclosure

- a. The enclosure shall be of the aluminum alloy weatherproof walk-in type and designed for a rigidity wind test of 150 miles per hour. Provide angle iron frame with minimum 1-1/2" x 1/8" angle iron steel. The enclosure shall be sized by the manufacturer to meet the requirements for proper air flow and clearances as required for accessory equipment. It shall be compliant with the Kentucky Building Code, which is based on the 2012 International Building Code.
- b. Each door shall have provisions for locking and interior panic hardware as required by Kentucky Building Code. Locks must be coordinated with the existing building door hardware such that the genset enclosure uses the same keys as the existing buildings. Owner will provide a key for manufacturer's use in keying the hardware. A minimum of two doors are required – one at each end of the enclosure.
- c. Roofs shall be domed and provided with rain gutters where required to prevent water from entering the enclosure. Roof loading capacity shall be a minimum of 80 lbs. per square foot.
- d. The air intake opening shall be louvered with aluminum motorized 120 volt dampers equal to Arrow model AE-40. A duct flange with a flexible section shall be supplied to attach the louver to the radiator. The exhaust shall be louvered with gravity dampers.
- e. The enclosure shall be insulated with 1" Styrofoam insulation material. It must be completely covered with 22 gauge galvanized sheet steel. Alternately, the enclosure may be insulated with 1" fiberglass insulation with perforated metal facing. See sound attenuation requirements below.
- f. Provide 208 volt, AC, 3-phase, electric fan-forced unit heaters with thermostat supplied and wired and sized to maintain a minimum 60°F enclosure space temperature in the minimum ambient listed above.
- g. Enclosure shall be prewired such that only one 208 volt 3-phase service is required. All disconnects, panelboards and transformers shall be included.
- h. Provide LED lighting sufficient to provide 40 footcandles inside the enclosure at the floor. Provide 3-way switches at each door and a minimum of 2 duplex NEMA 5-20 R

receptacles. Provide interior LED emergency lighting sufficient to provide 1 footcandle at the floor on all accessible sides of the generator, and exterior exit discharge normal and emergency lighting sufficient to provide 1 footcandle on the egress pathways/stairs in accordance with the KY Building Code. The lighting shall be coordinated with the building electrical supplier such that the same make/model of fixtures are provided in the genset enclosure as are provided in the electrical building. See the Light Fixture schedule on the Drawings.

- i. Provide removable lifting eyes at each corner of the enclosure.
 - j. Color shall be tan smooth glossy. Submit color chart for Owner confirmation during submittal review.
- 2. Platforms: furnish OSHA approved stairs with stoop to access each door on the enclosure. The stairs shall be aluminum and shall support a weight of 500 lbs minimum. The stairs shall be a rigidly-welded one-piece set for each door and shall have arrangements for rigidly mounting to the same concrete pad as the generator.
- 3. The assembly shall be tested to ensure that there is no loss of generator set performance while operating in the enclosure.
- 4. Exhaust insulation: furnish and install insulation suitable for use at temperatures up to 1,500 degrees Fahrenheit on the engine generator set exhaust piping and silencer to prevent heat buildup in the enclosure, provide noise reduction, and optimize operator safety. The insulation shall be custom made to fit the actual layout and the insulating media shall consist of 2 inch molded calcium silicate as manufactured by Celotemp, or equal. The calcium silicate shall be mitered to fit contours and fittings with all voids filled with high temperature insulating cement (asbestos free). Pipe and fitting insulation shall have a finish of 0.016 inch smooth aluminum sheeting held in place by stainless steel bands.
- I. Remote Annunciator & SCADA: Provide a remote annunciator with NFPA-110 lights and sufficient cable to install the annunciator as indicated on the Drawings. Also provide dry contacts for remote monitoring of the following signals: generator running status, generator fault/alarm, generator low fuel level.
- J. Sound Attenuation: Provide sound attenuation such that the noise generated by the diesel generator set operating at 100 percent load shall not exceed 85 dBA sound pressure level when measured at any angle 23 feet away from the enclosure.

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2.03 AUTOMATIC TRANSFER SWITCH

- A. See Section 16496 for requirements.

2.04 FUEL STORAGE SYSTEM

- A. Fuel System runtime capacity shall be 24 hours at full load.
- B. Sub-base tank
 - 1. Provide a UL labeled double walled sub-base tank for each emergency generator. The tank shall incorporate threaded pipe connections. The tank shall be complete with all level controls, fuel site gauge, and low level alarm detector, all prewired. The low level detector shall have a dry contact for field wiring connections. Provide a whistle valve vent such that a whistling noise is emitted when the tank is full.
 - 2. Provide flexible connections from the tank to the engine.

2.05 ACCESSORIES

- A. Provide hearing protectors, earmuff type, Willson No. 365, fibermetal No. 2011 or equal - 2 sets required - one set hung at each entrance door.
- B. Provide a weatherproof Class B fire extinguisher, 10lb min, installed inside the genset enclosure.

PART 3 - EXECUTION

3.01 GENERATOR SET INSTALLATION / APPLICATION / ERECTION

- A. The design and construction of the electric generator sets shall be such that they are neat and clean in appearance, and that normal adjustments and maintenance can be effected without use of special tools. See Drawings for generator installation details.
- B. The engine shall be filled with all necessary liquids required for operation. The fuel tank shall be filled full of fuel prior to startup day.
- C. The Contractor shall strictly adhere to this specification and the approved shop drawings and manufacturer's installation instructions for the installation of the generator system and its accessories.
- D. Base shall be installed on a concrete foundation and anchored to the foundation in accordance with manufacturer's recommendations and the Contract Drawings. Other aspects of the installation shall be per Contract Drawings, manufacturer recommendations, and NFPA 30.

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3.02 STARTUP AND TRAINING

- A. Provide installation inspection and startup by manufacturer's authorized representative. A startup report is required. Contractor is required to correct all deficiencies noted in the startup report prior to acceptance.
- B. Provide one day of training for Owner personnel after genset is operational. Training shall be conducted independently of the startup and shall be coordinated with Owner personnel.

3.03 ANNUAL SERVICE

- A. Provide a complete preventative maintenance inspection, test, and filter/fluid change at one year from startup. Any defects found shall be repaired under warranty. The cost of this first annual service shall be included in the bid price.

END OF SECTION

SECTION 16280
SURGE PROTECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide transient voltage surge suppressors (TVSS) for distribution equipment (panelboards) as indicated on the Drawings and as specified herein.
- B. Provide transient voltage surge suppressors and other surge protective devices (SPDs) for all systems and equipment as indicated on the Drawings, as specified herein, and as specified in individual Specification sections in Division 16 and 17.

1.02 RELATED WORK

- A. Section 16010 - General Electrical Requirements
- B. Section 16670 - Lightning Protection Systems
- C. Section 16442 - Panelboards
- D. Section 16900 - SCADA Hardware

1.03 SUBMITTALS

- A. Submit product data on all surge protective equipment. Catalog data shall include all information necessary to prove compliance with this Specification. Proposed part numbers and options shall be flagged, and non-applicable equipment shall be crossed out. Provide a table of each suppressor location. Installation instructions and drawings shall also be included with the shop drawing submittal.
- B. Clearly note all options being submitted with underlines in product literature. Provide a list for each model number of suppressor and corresponding service used.
- C. TVSS specifications shall include UL 1449 surge suppression ratings.
- D. Submit operation and maintenance information on all surge protective equipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Switchboard, MCC, and Panelboard Transient Voltage Surge Suppressors – Eaton, Square D, GE, Siemens, or equal.
- B. Equipment SPDs - “Phoenix Contact,” “Eaton,” “ABB,” “Transtector,” or equal.

2.02 GENERAL REQUIREMENTS

- A. Surge protection equipment operating temperature shall be -20°F to 125°F, minimum range.
- B. TVSS equipment shall be UL 1449 listed.

2.03 PANELBOARD SPD/TVSS

- A. The TVSS shall be suitable for application in category C3 environments as described in ANSI/IEEE C62.41. The TVSS shall be of parallel design and provide protection, line to ground, neutral to ground, and line to neutral for wye or delta distribution systems. The TVSS shall be compatible with the indicated electrical system, voltage, current and distribution configuration.
- B. Non-listed manufacturers shall submit oscillographs and/or computer generated graphs from compatible smartscopes, which demonstrate TVSS clamping voltage values when tested to category C3 (per ANSI/IEEE C62.45) 6kV 1.2x50 microseconds and 10kA 8x20 microseconds test waveshapes, in all specified suppression modes.
- C. TVSS shall comply with ANSI/IEEE C62.1, C62.41, and C62.45. The TVSS shall be capable of surviving 1,000 sequential category C3 surges without failure following IEEE test procedures established in C62.45.
- D. TVSS shall have 200kA short circuit current ratings. TVSS shall have thermal disconnects to protect against overvoltage conditions.
- E. The TVSS shall use redundant LED indicators that provide indication of suppression failure.
- F. The TVSS maximum continuous operating voltage (MCOV) shall be capable of sustaining 110 percent of the nominal RMS voltage continuously without degradation.
- G. The TVSS shall use only solid state clamping components to limit the surge voltage.

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- H. Distribution Panelboard TVSS shall have a surge current capacity of 40,000 amps minimum per mode.
- I. The TVSS shall have a response time no greater than 5 nanoseconds, for any of the individual protection modes, under laboratory conditions with optimum lead lengths.
- J. The TVSS UL 1449 surge suppression rating for any suppression mode shall not exceed:

Electrical System Voltage	Phases	UL 1449 Surge Suppression Ratings
120/240	1	330V
120/240	3	330V
120/208	3	330V
208	3	700V
277/480	3	700V

- K. EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.
- L. The TVSS components shall have a SPDT alarm contact rated for 250 VAC, 1 amp (minimum) used for remote indication of circuit integrity.
- M. TVSS shall be equipped with a non-resettable digital event counter readable on the face of the suppressor without opening any doors or covers.

2.04 CABINET/CONTROL PANEL SPD

- A. The SPD shall be a Din-Rail-Mounted device and shall be installed to protect the equipment in the cabinet from harmful surges and voltage spikes. The SPD shall have a SPDT contact rated for 250 VAC, 1 amp used for remote indication/visual indicator of circuit integrity.
- B. It shall have a surge handling capacity of 10kA (8/20microsecond) minimum. It shall have hybrid technology for “fine” voltage clamping and “coarse” surge current handling. The clamping voltage shall be less than or equal to 500V. The response time shall be less than or equal to 25 nanoseconds.
- C. The device shall be a Phoenix Contact “Valvetrab” or equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. The conductors shall be as short and straight as practically possible and shall not exceed 6 feet in length or the manufacturer’s maximum

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recommended length (whichever is less). The input conductors are to be twisted together to reduce the TVSS system inductance. An appropriately sized manual safety/disconnect switch or thermal magnetic circuit breaker shall be installed on the line side of the TVSS. It shall be capable of electrically isolating the TVSS from the electrical service for repair without interrupting service to the building.

- B. The TVSS shall be installed following the TVSS manufacturer's recommended practices and in compliance with all applicable codes.

3.02 CABINET TVSS

- A. Provide a Cabinet TVSS on all single phase control panels, SCADA and electronic cabinets, and all other equipment with solid-state circuitry.

END OF SECTION

SECTION 16312

UNDERGROUND MEDIUM VOLTAGE POWER DISTRIBUTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The underground power distribution system shall be installed in accordance with NEC and NESC requirements, and as written herein and as shown on Contract Drawings.

1.02 SUBMITTALS

- A. Submit the following for approval:
 - 1. Medium voltage cable, joints/splices, and terminations
 - 2. Precast concrete structures/manholes/pullboxes
 - 3. Sealing Material
 - 4. Cable supports, including racks, arms, and insulators
 - 5. Protective Devices and Coordination Study: The study shall be submitted with other required protective device equipment submittals.
- B. Submit the cable installer/terminator qualifications/certificate.
- C. Submit results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

1.03 QUALITY ASSURANCE

- A. Certificate of Competency for Cable Installer/Splicer/Terminator: Certification of the qualification of the cable installer/splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has been trained in splicing and terminating medium voltage cables.
- B. Medium Voltage Cable Qualification and Production Tests: Perform AEIC CS8 qualification and production tests for each type of medium voltage cable.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Duct Spacers and Terminators
 - 1. Duct spacers and terminators shall be Formex, or equal.
- B. Medium Voltage Insulated Power Cables
 - 1. Medium voltage insulated power cables shall be Okonite, or equal.
- C. Prefabricated Splice Kits and Terminations
 - 1. Prefabricated stress cones, shield grounding adapters, splice kits, and terminations shall be as manufactured Elastimold, 3M, Cooper, or equal.

2.02 MATERIALS

- A. Conduit
 - 1. Underground duct lines for medium voltage shall be PVC, concrete encased. Schedule 40 may be used in lieu of Schedule 80 where concrete-encased.
- B. Conduit Sealing Compound: Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.
- C. Duct Spacers and Terminators
 - 1. Spacers shall be made from high density polyethylene, and shall be double wall construction. They shall consist of interlocking modules, i.e. bases, intermediates and caps. Base pads shall be used to assure specified dimensions between trench floor and bottom of first tier of ducts. The interlocking modules shall include an internal vertical channel on both side edges of the spacers. The interlocking module spacers shall provide independent support for each duct, and 3 inch separation between ducts.

2. Terminator modules shall be made from high impact, high strength, prime virgin acrylonitrile butadiene styrene (ABS) plastic, Marbon Type G.S., or equal. Terminator module shall interlock and be sealed together using a recommended plastic solvent cement. The openings of the terminator facing the inside of the manhole shall be belled.

D. MEDIUM VOLTAGE CABLE

1. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Provide single conductor type cables unless otherwise indicated.
2. Cable Configuration: Provide Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072. Provide cables manufactured for use in duct applications as indicated. Cable shall be rated for indicated voltage with 133 percent insulation level.
3. Conductor Material: Provide concentric-lay-stranded, Class B conductors. Provide soft drawn copper cables complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.
4. Insulation: Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659 and AEIC CS8. 15 KV cable shall be 220 mils EPR.
5. Shielding: Cables shall have a 5 mil copper tape with 10% minimum overlap.
6. Neutrals: Neutral conductors shall be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable. For high impedance grounded neutral systems, the neutral conductors from the neutral point of the transformer or generator to the connection point at the impedance shall utilize copper conductors, employing the same insulation level and construction as the phase conductors.
7. Jackets: Cables shall be provided with a PVC jacket. Provide PVC jackets with a separator that prevents contact with underlying semiconducting insulating shield.
8. Temperature Rating: 105°C continuous, 140°C emergency, 250°C short circuit

E. MEDIUM VOLTAGE CABLE JOINTS

1. Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of

the cable. Joints shall be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2. Heat-Shrinkable Joint: Shall consist of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.
3. Cold-Shrink Rubber-Type Joint: Joint shall be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket shall be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice shall be packaged three splices per kit, including complete installation instructions.

E. Prefabricated Terminations

1. Molded Rubber Cable Termination: The shielded cable termination must be capable of normal continuous operation at the rated voltage and current on the cable it is to be used on (up to 35 KV); and it should meet all the requirements of a Class 1 Termination as given in IEEE Standards. The termination must consist of a high quality rubber molded stress cone made of track resistant peroxide cured EPR rubber and a one-piece silicone rubber skirted insulator for 15 KV (two-piece silicone skirted insulator for 25 and 35 KV). A mechanical (non-solder) ground strap assembly shall be included as a part of the kit. All materials (except lug) necessary to make three terminations shall be included as part of the basic 5 to 15 KV kit. This should include cable preparation materials.
2. Porcelain Shielded Cable Termination: The shielded cable termination must be capable of normal continuous operation at the rated voltage and current on the cable it is to be used on (up to 25 KV) and should meet all the requirements of a Class 1 Termination as given in IEE Standard 48-1996. The termination must have a high quality wet process porcelain insulator whose sky blue color conforms to Munsell 5BG 7.010.4 with a sealed metal top cap. Grounding of the shield shall be accomplished by means of a mechanical grounding strap. The termination shall be potted by use of a chemically thermosetting self-curing elastomeric compound requiring no additional heat. the electrical stress at the edge of the cut-off shield shall be controlled and reduced by use of a material possessing a dielectric constant of approximately 30. The termination shall have a single tongue mounting ring as an

integral part which can be attached to a standard cross arm bracket.

3. Shield Grounding Adapter: The shield ground adapter must be capable of use at the rated voltage of the cable it is used on, and shall be totally mechanical, requiring no soldering or taping. It shall be watertight. The housing shall be molded conductive rubber. The ground lead shall be copper. Contact with the cable shield shall be by compression of a corrugated internal contact. Compression shall be accomplished by external stainless steel clamp(s).
4. Loadbreak Elbow Connectors and Accessories
 - a. Insulated high voltage cable shall be terminated using deadfront elbows at padmount transformers. Voltage class shall be 15 KV. The insulating elbows shall be molded of EPDM rubber with integral stress cones. The 200 ampere devices shall accept No. 6 - No. 4/0 conductors. Connectors shall be watertight and shall include all accessories needed for connection to conductor. Other characteristics:

Impulse Voltage: 95 KV BIL
Withstand Voltage: 34 KV, 60 Hz., 1 Minute
Minimum Corona Extinction Level: 11 KV
Momentary: 10,000 amps RMS Symmetrical
 - b. Cable shield grounding adapters shall be furnished and installed as needed. Necessary bushing shall be furnished and installed in switches and transformers for proper mating with the elbow connectors. Feed through bushings shall be used at transformers so that deadfront arresters may be connected to the unused feed through bushing.
 - c. The deadfront arrester shall be gapless, of solid state design using a metal oxide varistor enclosed in a molded elbow similar to the elbow connector housing.
 - d. Furnish insulated protective caps where needed to maintain the deadfront, watertight arrangement where a bushing is unused.

F. UNDERGROUND STRUCTURES

1. Provide precast concrete underground manhole types as indicated, conforming to ASTM C 857 and ASTM C 478 with a 28 day compressive strength of 4000 psi. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking.

Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and rises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
3. Design for Precast Structures: ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:
 - a. Angle of Internal Friction (ϕ) = 30 degrees
 - b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf
 - c. Coefficient of Lateral Earth Pressure (K_a) = 0.33
 - d. Ground Water Level = 3 feet below ground elevation
 - e. Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.
 - f. Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.
 - g. Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.
 - h. Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

4. Construction: Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.
5. Joints: Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.
6. Manhole Frames and Covers: Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "HIGH VOLTAGE" in the top face of power manhole covers.

H. CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

1. The metal portion of racks and arms shall be zinc-coated after fabrication.
2. Cable Racks: The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.
3. Rack Arms: Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of 8 inches and a maximum of 12 inches.
4. Insulators: Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

I. CABLE TAGS IN MANHOLES

1. Provide tags for each power cable located in manholes. The tags shall be polyethylene with $\frac{3}{4}$ " black text (minimum) on yellow background. Do not provide handwritten letters. The first position on the power cable tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. As an example, a tag could have the following designation: "12.47kV Filter Bldg Phase A- 500kcmil," denoting that the tagged cable is on the 12.47kV system for the Filter building, Phase A, sized at 500 kcmil.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

- A. Ends of conduits shall be sealed where they enter buildings at service equipment and empty (spare) conduits shall be capped at both ends. Spare conduits shall extend 5 feet from buildings or structures unless otherwise shown on the Contract Drawings.
- B. Duct
 1. General
 - a. The duct system shall consist of single or multiple round-bore conduit for the electrical-distribution system. The number and size of the ducts shall be as indicated on the Contract Drawings. Duct lines shall be laid to a minimum grade of 4 inches per 100 feet. Duct shall be laid so that the top of the duct is 36 inches below finished grade or finished paving. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at the ends of the run. The long sweep bends may be made up of one or more curved or straight sections and/or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with ducts of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Conduits shall terminate in end bells where duct lines enter manholes. Conduit shall be thoroughly cleaned before using or laying. During construction and after the duct line is completed, the ends of the conduit shall be plugged to prevent water washing mud into the conduits or manholes. Particular care

shall be taken to keep the conduits clean of concrete, dirt, and any other substance during the course of construction.

- b. Where it is necessary to cut a tapered end on a piece of conduit at the site, the cut shall be made with a tool or lathe designed to cut a taper to match the taper of the particular conduit being used. After the duct line has been completed, a standard flexible mandrel not less than 12 inches long, having a diameter approximately 1/4 inch less than the inside diameter of the conduit, shall be pulled through each conduit, after which a brush with stiff bristles shall be pulled through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Pneumatic rodding may be used to draw in the lead wire. Where connection is made to an existing duct that is of different material and shape than the duct line being installed, a suitable coupling of a type recommended by the duct manufacturer shall be used. Conduits shall be stored to avoid warping or deterioration. Plastic conduit shall be stored on a flat surface and protected from the direct rays of the sun. Conduit joints in concrete encasement may be placed side by side horizontally but shall be staggered at least 6 inches vertically.
- c. Each single conduit of the duct bank shall be completely encased in concrete if indicated on the Contract Drawings. The thickness of the concrete encasement indicated is the minimum thickness, and may be increased to fit the actual shape of the trench. Duct spacers shall be used, placed on 4 feet centers. When the duct bank is assembled, a No. 3 reinforcing rod shall be passed through the internal vertical channels on one side of the spacer bank and driven into the trench floor. At the next spacer location, the No. 3 rod shall be inserted on the opposite side, etc. The reinforcing rods shall be bent inwardly at the top of the spacer bank sufficiently to squeeze the spacer cap so the duct assembly will not float or move in any direction during the concrete pour. Concrete encasement shall not be less than 3 inches on the side, bottom, and top of the conduits.

2. Couplings

- a. Joints in conduit shall be made up in accordance with the manufacturer's recommendations for the particular conduit and coupling used. The plastic or fiberglass conduit joints shall be made up by brushing a plastic solvent cement or epoxy (as applicable) on the inside of the coupling and on the outside of the conduit ends. The conduit and fitting shall then be slipped together, until seated, with a slight twist to set the joint tightly, and the conduit then rotated 1/2

turn to distribute the cement evenly. Excess cement build up on the inside surface of the conduit shall then be removed.

B. Manholes

1. Manholes shall be installed at locations shown on the Contract Drawings. Details of construction shall be as shown on the Contract Drawings as specified herein. A cable pulling iron shall be installed in the wall opposite each duct line entrance if necessary. Manholes shall be arranged to drain.

C. Grounding

1. Provide grounding system in accordance with NFPA 70 and IEEE C2, and as specified herein. Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding 5 ohms at pad-mount transformers, manholes, etc. Ground rods shall be $\frac{3}{4}$ "x10' and connections shall be exothermic weld. Grounding conductors shall be minimum 6 AWG copper. Braided copper strap shall be used for grounding metallic frames and covers of manholes.
2. Medium Voltage Manhole Grounding: Loop a #2 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with #2 AWG conductor. Connect all incoming grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all metal cable racks, and other metal equipment with a minimum 6 AWG conductor. Cable shields are only required to be grounded at the ends of the cable and at splices. It is not necessary to ground cable shields at pull-through only boxes if there is no splice.

D. Medium Voltage Insulated Power Cable Systems

1. The power cable systems shall consist of ethylene-propylene rubber insulated PVC jacketed conductors. The size and number of conductors shall be as indicated on the Contract Drawings. Power cables shall be installed in duct lines as specified this section.
2. It is intended that cables be continuous as much as is practical without unnecessary splices. Cable splices, however, shall be made in manholes or junction boxes if necessary, and shall be installed at no extra cost to the Owner. Cable splices and terminations shall be made up in accordance with cable manufacturer recommendations, by persons qualified to make such splices/terminations.

3. Cable pulling shall be accomplished using industry recognized pulling equipment and techniques, and shall be done in accordance with cable manufacturer's recommendations. All cable shields shall be grounded at both ends.

4. Install a cable tag on each cable in each manhole.

E. Prefabricated Splice Kits and Terminations

1. Splices and terminations shall be of a type appropriate for the cable type and for the environment encountered, either indoor or outdoor. All kits shall include premolded stress cones and all necessary materials needed for proper installation. The Contractor shall furnish necessary lugs, etc. for mechanical hookup from cables to equipment.

2. All terminations and splices shall be installed in accordance with manufacturer recommendations and shall be complete with all necessary accessories for an operational system. All terminations and splices shall be made prior to cable Hipot testing. All lightning arresters shall be properly grounded. All terminations in outdoor cabinets shall be treated as outdoor and terminated accordingly.

3.02 FIELD QUALITY CONTROL

A. A DC Hipot test shall be conducted on all cables before hookup and after pulling, when the cables are fitted with all terminating and splicing kits. testing shall be in accordance with IEEE and manufacturer recommendations with test voltage for each cable as advised by the manufacturer. All cable shields shall be grounded during testing and ends of cables under test adequately insulated from grounded equipment and other equipment not under test. Submit a written report of test results to the Engineer on all cables.

B. Prior to Hipot testing, the Contractor shall utilize a high voltage megger to detect gross insulation system failure. The Hipot test on a very low quality insulated cable is destructive, and screening the cables first with the megger may prevent the Contractor replacing an otherwise salvageable cable.

C. Hipot testing shall also be performed on existing cables which have been disturbed during the course of this work.

END OF SECTION

SECTION 16361

MEDIUM VOLTAGE ARC RESISTANT LOAD INTERRUPTER SWITCHGEAR

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the medium voltage load interrupter switchgear as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

- A. Section 16010 – General Electrical Requirements

1.03 REFERENCES

- A. The medium voltage load interrupter switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:

1. ANSI/IEEE C37.20.3
2. ANSI/IEEE C37.20.4
3. IEEE Testing Guide C37.20.7
4. ANSI C37.22
5. ANSI C37.57, C37.58
6. NEMA SG5
7. NEMA SG6
8. CSA 22.2 No.31-M89 (5/15 kV ratings only)
9. CSA 22.2 No. 193
10. CSA 22.2 No. 58

- B. Listing by Underwriters Laboratories (UL) shall be provided for 15 kV class medium voltage arc resistant load interrupter switchgear.

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 1. Master drawing index
 2. Front view elevation

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3. Floor plan
 4. Top view
 5. Single line
 6. Nameplate schedule
 7. Component list
 8. Conduit entry/exit locations
 9. Assembly ratings including:
 - a. Main cross bus momentary and short time short-circuit withstand ratings
 - b. Voltage
 - c. Continuous current
 - d. Basic Impulse Level
 - e. Enclosure internal arc short circuit rating and duration
 10. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
 11. Cable terminal sizes
- B. Where applicable or required by the Engineer the following additional information shall be submitted to the Engineer:
1. Bus duct connection
 2. Connection details between close-coupled assemblies
 3. Composite floor plan of close-coupled assemblies
 4. Electrical schematic diagram
 5. Key interlock scheme drawing and sequence of operations
 6. Descriptive bulletins
 7. Product data sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 - 2. Wiring diagrams
 - 3. Certified production test reports
 - 4. Installation information including equipment anchorage provisions
 - 5. Seismic certification as specified

1.06 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- B. Each switchgear assembly shall be split into shipping groups for handling as indicated on the drawings or per the manufacturer's recommendations. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be packaged and shipped separately. Each switchgear shipping group shall be equipped with lifting eyes for handling solely by crane.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

1.09 MANUFACTURERS

- A. Eaton Corporation
- B. Schneider Electric
- C. General Electric

1. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

1.10 RATINGS

- A. Switchgear assembly ratings shall be as follows:

1. Nominal System Voltage 12.47/7.2 kV 3 wire
2. System Grounding See One-Line Diagram
3. Rated Maximum Voltage 15 kV
4. Rated Lightning Impulse Withstand Voltage (BIL) 95kV
5. Arc Resistant Accessibility Type Type 2B per IEEE C37.20.7
6. Main Cross Bus Continuous Current 600 A
7. Main Cross Bus Momentary Current (10 Cycle) ⚡40 kA rms Asym/65 kA peak
8. Main Cross Bus 2-Second Short Circuit Current ⚡25 kA rms Sym
9. Enclosure Internal Arc Short Circuit Rating ⚡25 kA rms Sym/65 kA peak
10. Enclosure Internal Arc Short Circuit Duration 0.5 second
11. Non-Fused Switch (Continuous and Load Break current) ⚡600 Amperes
12. Non-Fused Switch Fault Close and Momentary withstand ⚡40 kA rms Asym
13. Non-Fused Switch 2-Sec Short-time short-circuit current ⚡25 kA rms Sym
14. Fuse Rating As shown on drawings
15. Type of Fuse ⚡RBA-400

- | | | |
|-----|--------------------------------------|------------------|
| 16. | Fuse Interrupting Rating | ☞ 25 kA Sym RMS |
| 17. | Fused Switch Fault close & Momentary | ☞ 40 kA Asym RMS |

1.11 15 KV CONSTRUCTION

- A. The metal-enclosed load interrupter switchgear shall consist of deadfront, completely metal-enclosed vertical sections containing load interrupter switches and fuses of the number, rating and type noted on the drawings or specified herein.
- B. The following features shall be supplied on every vertical section containing a three-pole, two-position open-closed switch:
- C. A minimum 5-inch x 18-inch high-impact viewing window that permits full view of the position of all three switch blades through the closed door. Open Switch Blades should provide adequate AIR (normal air) clearance to provide full dielectric insulation between Line and load per IEEE C37.30.4 without the use of insulators or insulating gasses. The window shall not be more than 58-inches above the switch pad level to allow ease of inspection
- D. The fuse compartment door shall be interlocked with the switch so that:
 - 1. The switch must be opened before the fuse compartment door can be opened.
 - 2. The fuse compartment door must be closed before the switch can be closed.
 - 3. Switch compartment door shall be interlocked such that it cannot be opened until the switch has been locked open and fuse compartment door has been unlocked and opened.
 - 4. Provision for padlocking the switch in the open or closed position
 - 5. Green OPEN, Red CLOSED switch position indicators with the words "Open" and "Closed" in French, Spanish and English
 - 6. A hinged cover with rustproof quarter turn nylon latches over the switch operating mechanism to discourage casual tampering
 - 7. The switch shall be removable from the structure as a complete operational component
- E. Vertical section construction shall be of the universal frame type using die-formed and bolted parts. All enclosing covers and doors shall be fabricated from steel with thickness equal to or greater than that specified in ANSI/IEEE C37.20.3. No owner removable hardware for covers or doors shall be thread-forming type. To facilitate installation and maintenance of cables and bus in each vertical section, padlockable hinged rear covers held closed by bolts shall be provided.

- F. Each vertical section containing a switch shall have hinged, bolted upper and lower front doors for access to load interrupter switch and fuse compartments. Switch operating mechanism shall be easily accessible from the front without requiring opening of main front doors. Removable handle shall be provided for manual operation of the switch. Provide storage provision for the removable handle within the switch operating mechanism box.
- G. Each load interrupter switch shall have the following features:
 - 1. Three-pole gang-operated mechanism
 - 2. Manual quick-make, quick-break over-toggle-type mechanism that does not require the use of a chain or a cable for operation, and utilizes a heavy-duty coil spring to provide opening and closing energy
 - 3. The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position under normal operation
 - 4. Separate main and break contacts to provide maximum endurance for fault close and load interrupting duty
 - 5. Insulating barriers between each phase and between the outer phases and the enclosure
 - 6. A maintenance provision for slow closing the switch to check switch blade engagement and slow opening the switch to check operation of the arc interrupting contacts

1.12 BUS

- A. All phase bus conductors shall be tin-plated copper.
- B. Ground bus shall be silver-plated copper and be directly fastened to an unplated metal surface of each vertical section, and be of a size sufficient to carry the rated (2-second) current of the switchgear assembly.

1.13 BUS INSULATION SYSTEM

- A. All bus shall be supported utilizing a high strength and high creep support providing 10.5-inch of creep distance between phases and ground. The molded fins shall be constructed of high track resistant polyester or cycloaliphatic epoxy.
- B. All standoff insulators on switches and fuse mountings shall be glass polyester or cycloaliphatic epoxy.

1.14 WIRING/TERMINATIONS

- A. One (1) terminal pad per phase shall be provided for attaching contractor-supplied cable terminal lugs for a maximum of two (2) conductors per phase of the sizes indicated on the drawings. Sufficient space shall be allowed for contractor supplied electrical stress relief termination devices.
- B. Small wiring, fuse blocks and terminal blocks within the vertical section shall be furnished as indicated on the drawings. Each control wire shall be labeled with wire markers. Terminal blocks shall be provided for owner's connections to other apparatus.

1.15 FUSES

- A. Fault protection shall be provided by fuses with continuous ratings as shown in the contract documents. Any fuse/switch integrated momentary and fault close ratings specified shall have been verified by test and UL and CSA certified.

1.16 ENCLOSURES

- A. Enclosures shall be constructed per IEEE/ANSI C37.20.3.
- B. Switchgear enclosure shall provide protection against internal arcing faults at the front, sides, and rear as defined by accessibility Type 2B under ANSI test guide C37.20.2.
- C. In the event of an internal arcing fault, the resulting arc pressure and the exhaust shall be directed upward and into the plenum fitted above each section.
- D. Provide a barrier between load-break switch compartment and fuse compartment to maintain arc resistant protection when accessing the fuse compartment after the switch has been locked open. Note to spec writer – Please note that this optional barrier is only available for circuits where outgoing load cables exit the switchgear from the bottom, and it requires structures with minimum 53-inch depth.
- E. The switchgear shall be installed inside an electrical room. An enclosed arc exhaust plenum shall be furnished for installation above the switchgear. Arc exhaust shall be vented from the arc-plenum to the exit location via arc-duct as shown on the drawings. Arc duct shall be supplied by the switchgear manufacturer. Field assembly of the arc-plenum and arc-duct shall be by installing contractor.

1.17 NAMEPLATES

- A. A nameplate shall be mounted on the front door of each switch vertical section in accordance with the drawings.

1.18 FINISH

- A. Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, then fused-on by baking in an oven. The coating is to have a thickness of not less than 1.5 mils. The finish shall have the following properties:

Impact resistance (ASTM D-2794)	60 direct/60 indirect
Pencil hardness (ASTM D-3363)	H
Flexibility (ASTM D-522)	Pass 1/8-inch mandrel
Salt spray (ASTM B117-85 [20])	600 hours
Color	ANSI 61 gray

PART 2 PART 3 EXECUTION

2.01 3.01 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
- B. The manufacturer shall provide three (3) certified copies of factory test reports.

2.02 3.02 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

2.03 3.03 MANUFACTURER'S CERTIFICATION

- A. The Contractor shall provide a qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

2.04 3.04 TRAINING

- A. The Contractor shall provide a training session for up to five (5) owner's representatives for one normal workday at a job site location determined by the owner.

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- B. The training session shall be conducted by a manufacturer's qualified representative and consist of instruction on the assembly, switches and major components.

2.05 3.05 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

END OF SECTION

SECTION 16440
MOTOR CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall furnish and install motor control equipment as specified herein and as shown on the Drawings.

1.02 RELATED WORK

- A. Section 16010 – General Electrical Requirements

1.03 SUBMITTALS

- A. Motor control equipment shall be new and the equipment of one manufacturer. Each component is specified by a particular trade name; however, this does not relieve the Contractor of the responsibility of submitting descriptive literature and Shop Drawings for review of all components.
- B. Shop drawings, including layout drawings, complete schematic and composite wiring diagrams, control circuit wiring diagrams and descriptive literature shall be submitted to the Engineer for review. Service manuals shall be submitted on all equipment and shall be bound in 3-ring looseleaf binders. The manuals shall also include information on accessories such as timers, etc., built in the control center.
- C. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted. Product literature with one or more styles / configurations for a single product shall have a written description of use for each of the styles / configurations represented on the literature. For example: Device boxes – Styles shall be listed as: For masonry walls, for electrical devices, for ceiling mounted light fixtures, etc.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Control Equipment
 - 1. “Square D”, “Eaton”, “General Electric”. “Allen-Bradley” or equal.

2.04 INDIVIDUALLY MOUNTED MOTOR CONTROL DEVICES (480, 240, OR 120 VOLT)

A. General

1. All motor control equipment shall be new and the product of 1 manufacturer. All individually mounted disconnects, push-button stations, latchout stations, starters, etc., indoors shall be mounted on a 1 inch strut to provide an air space at rear.

B. Starters

1. General

- a. All starters shall be of the voltage rating, type, and sized for the motor size shown in these Specifications and/or on the Contract Drawings. For enclosure type see the system operation description and/or the Contract Drawings. All starters shall be of the magnetic type. Should a piece of electrically driven equipment be furnished with a larger motor than shown on the Contract Drawings, the proper size combination starter shall be provided for the equipment supplied, at no extra cost to the Owner.
- b. See the Contract Drawings for the auxiliary equipment to be furnished. Maximum control voltage shall be 120 volts, a-c. Minimum starter size shall be NEMA Size 1.

2. Overloads

- a. Each starter shall have a thermal overload device in each ungrounded leg. The overload shall be of the "Ambient compensated Bi-metallic", thermal element type. All overloads shall be of the manual reset type and shall be reset without opening the starter enclosure. Heaters shall be sized for the proper temperature rise of the motor that it is being used on. Heaters for general service shall be of the standard trip type. Adjustable Overload Relay Thermal Units are not allowed. All integral horsepower motors, 15 horsepower and over, require thermal elements embedded in the windings. See Motor Specifications, this division. Siemens-Allis overload relays shall be provided with a meter-sealed cover over relay adjustment controls.

3. Contactors

- a. All contactors for motor starters shall be of the a-c magnetic type with "undervoltage" protection when used in conjunction with momentary contact push-button control and "undervoltage" release when used with maintained contact push-button control.

- b. Contactor size shall be in accordance with NEMA Standards for the motor controlled and shall be horsepower rated.
- c. Contacts shall be of the heavy duty silver-to-silver type and shall be totally enclosed in individual arc quenching chambers. Contacts shall be easily accessible for replacement.
- d. The contactor coil shall be of the vacuum impregnated or epoxy resin type, moisture resistant and corrosion proof.

C. Control Stations

1. General

- a. Control stations shall be heavy duty, maintained or momentary contact type, as noted on the Contract Drawings. Contacts shall be silver alloy, double break type. The number and marking of controls shall be as shown on the Contract Drawings. All control stations shall operate on 120 volt, a-c maximum, unless otherwise designated on the Contract Drawings.

2. Maintained Contact

- a. Maintained contact control switches shall be marked "On" and "Off". The button pushed shall remain in and push the other button out until the other button is pushed. In general, they are to be used for hand control of motors which have to operate continuously and restart whenever power is off then resumed, without any manual operator. This is needed for motors which have to operate continuously in the absence of an operator.

3. Momentary Contact

- a. Momentary contact control push-button switches shall be marked "start" and "stop". Pushbuttons shall spring out whenever pushed. If the circuit is dropped for any reason, operation cannot be resumed until a "start" push-button is pushed. In general, they are to be used for hand control of motors which are desired to operate intermittently in the presence of the operator and stop and start independently from more than one parallel control location.

D. Safety Switches

- 1. Safety switches shall be of the heavy-duty industrial, quick make, quick-break type. Ratings shall correspond to that of the

equipment in which circuit it is used, fuses sized as shown on the Contract Drawings. All safety switches at motor locations are of the nonfused type unless otherwise noted.

2. Safety switches shall have a mechanical door interlock to prevent the door from being opened with the switch in the on position and facilities for locking it in the closed or open position.
3. Safety switches shall be UL listed and shall conform to NEMA Standards.
4. NEMA 1 enclosed switches shall be phosphate coated or equivalent, code gauge steel with baked enamel finish.

E. Selector Switches

1. Hand-off-automatic type selector switches shall be of oil-tight construction and shall have 3 positions. The switch must not have a spring loaded return. It shall be of the "quick-make", "quick-break" type.
2. Selector switches for corrosive areas and water/wastewater plants shall be 30mm, NEMA 4X corrosion resistant, Square D Class 9001 Type SK or equal.

F. Pilot Lights and Pushbuttons

1. Pilot lights for corrosive areas and water/wastewater plants shall be 30mm, push-to-test, LED-style, NEMA 4X corrosion resistant, Square D Class 9001 Type SK or equal.
2. Pushbuttons for corrosive areas and water/wastewater plants shall be 30mm, NEMA 4X corrosion resistant, Square D Class 9001 Type SK or equal.

G. Manual Motor Starting Switches

Manual motor starting switches for the control of fractional horsepower motors shall be single pole, and shall be provided with a thermal heater of the correct size for the load controlled. Each starting switch shall be mounted where shown on the Contract Drawings. The motor starting switch shall be NEMA rated per the drawings. It shall be fiberglass in chemical or corrosive areas.

H. Timing Relays

Time delay relays shall have an adjustable timing range as shown on the Contract Drawings. The time delay shall be after energizing timer coil. Timing relays shall be Agastat, Square D, or equal.

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I. Control Relays

Control relays shall be magnetic, general purpose, "ice cube" type with 3-pole (minimum), double throw contacts rated at 5 amperes (minimum), 120 volts (minimum). Coils shall be rated to operate at the indicated control voltage. Provide proper bases, mounting track, etc. for a complete installation. All relays shall have a retainer clip, manual operator, and pilot light. Coils connected to solid-state digital outputs shall have transient surge protection.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. Individually Mounted Motor Control Devices (480, 240, or 120 Volt)

1. Each motor disconnect shall be located as near as possible to its respective motor.
2. Remote control station at or near motor shall be mounted near its respective motor, adjacent to the motor disconnect.

3.02 EXTRA STOCK/SPARE PARTS

A. Provide the following spare parts:

5 fuses of each type/amperage used

1 pilot light lamp for each pilot light socket assembly provided

1 control transformer for each size utilized

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide panelboards as indicated on the Drawings and as specified herein, including furnishing all labor, materials, equipment, and incidentals required for a complete installation.
- B. Circuit breakers of size and type shown on Contract Drawings and described herein shall be provided with the panelboards.

1.02 SUBMITTALS

- A. Shop Drawings, including Layout Drawings and complete over current protection devices descriptive literature shall be submitted to the Engineer for review.
- B. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted.
- C. Circuit assignments noted on the Drawings must match circuit assignments in all panelboards, and must be shown in shop drawings. Do not rearrange circuit numbering unless absolutely necessary due to inability to conform to the Drawings and then only rearrange the necessary breakers to match the Drawings as closely as possible.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. "Schneider/Square D", "Siemens", "General Electric," "Eaton." Substitution of alternate equipment shall be submitted for review to Engineer 10 days prior to bid.

2.02 EQUIPMENT

A. Rating

- 1. Panelboard ratings shall be as shown on the Contract Drawings. All panelboards shall be rated for the intended voltage.

B. Standards

- 1. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

C. Panelboard Construction

1. Interiors

- a. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.
- b. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.
- c. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.
- d. A nameplate shall be provided listing panel type, number of circuit-breakers and ratings.

2. Bussing

- a. Bus-bars for the mains shall be of copper. Full size neutral bars shall be included. Bus-bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
- b. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
- c. Spaces for future circuit-breakers shall be bussed for the maximum device that can be fitted into them.
- d. Separate neutral and ground bus shall be provided, insulated and isolated from each other.

3. Boxes

- a. Recessed boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.

- b. Surface mounted boxes shall have an internal and external finish as hereinafter specified. NEMA 1 surface mounted boxes shall be field punched for conduit entrances.
 - c. At least 4 interior mounting studs shall be provided.
- 4. Trims
 - a. Hinged doors covering all circuit-breaker handles shall be included in all panel trims.
 - b. Doors shall have semi flush type cylinder lock and catch, except that doors over 43 inches in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.
 - c. The trims shall be fabricated from code gauge sheet steel.
 - d. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with manufacturer's standard gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere without cracking or peeling.
 - e. Trims for flush panels shall overlap the box by at least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

D. Overcurrent Protective Devices (Circuit Breakers)

- 1. Panelboards shall be equipped with circuit-breakers with frame size and trip settings as shown on the Contract Drawings.
- 2. Circuit-breakers shall be molded case, bolt-in, thermal-magnetic trip.
- 3. Single Pole Circuit Breakers shall not be tied together to fabricate double or triple pole circuit breakers.
- 4. Circuit-breakers used in 120/208 volt panelboards shall have an interrupting capacity of not less than 10,000 amperes, RMS symmetrical.
- 5. Circuit-breakers used in 480 volt panelboards shall have an interrupting capacity of not less than 14,000 amperes, RMS symmetrical.
- 6. GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Contract Drawings. GFCI units shall be 1-pole, 120 volt, molded case, bolt-on circuit-breakers, incorporating a solid state ground

fault interrupter circuit insulated and isolated from the circuit-breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity of 10,000 amperes RMS.

7. Trip elements of multi-pole breakers shall be effectively insulated from one another. Multi-pole breakers shall be designed so that an overload on any pole shall open all poles simultaneously.
8. The breaker operating mechanism shall be the quick-make, quick-break type and shall be entirely trip free to prevent the contacts being held in a closed position against a short circuit.
9. Breakers shall have a thermal bimetallic element for time delayed overload protection and a magnetic element for short circuit protection.
10. The breaker shall be trip indicating with the trip position midway between the "On" and "Off" positions.
11. Breakers for power distribution panels shall be F frame or larger. All breakers rated above 225 amps shall have interchangeable magnetic trip elements.
12. All breakers shall be UL listed, and conform to requirements of NEMA Standards.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

- A. Boxes for surface mounted panelboards shall be mounted so there is at least ½ inch air space between the box and the mounting surface.
- B. Circuit directories shall be typed giving location and nature of load served.
- C. Each panelboard shall be nameplated with plastic engraved nameplates stating the panel's name, voltage, and the name of panel serving the panel. Nameplates shall be secured by use of stainless steel screws.

END OF SECTION

SECTION 16460

TRANSFORMERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide transformers as indicated and as specified herein. Transformer locations and size shall be as shown on the Contract Drawings.
- B. All transformers shall be non-PCB type.

1.02 SUBMITTALS

- A. Submit product data on all equipment. Provide a schedule describing the application of each transformer including item served, size and voltage of transformer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Schneider/Square D, General Electric, Siemens, Eaton, or equal.

2.02 FABRICATION

- A. General Purpose Dry-Type Transformers
 - 1. Single phase transformers shall be 480 or 600 volt primary and 120/240 volt secondary. Three phase transformers shall be 480 or 600 volts delta primary and 208 Y/120 or 240 volt delta secondary. Transformers 25 KVA and larger shall have a minimum of 4 (2 above, 2 below) 2-½ percent full capacity primary taps.
 - 2. Transformers shall be 150 degrees Celsius temperature rise above a 40 degrees Celsius ambient. All insulating materials are to be in accordance with the latest NEMA Standards for a 220 degrees Celsius UL recognized insulation system.
 - 3. Transformer coils shall be of the continuous wire wound construction and shall be impregnated with non-hygroscopic, thermo-setting varnish. The coils shall also have a final wrap of electrical insulating material to prevent mechanical injury to the wire as well as increasing the electrical breakdown strength.
 - 4. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with steel angles. The

completed core and coil shall then be bolted to the base of the enclosure but isolated from the base by means of rubber, vibration absorbing mounts. There shall be no metal-to-metal contact between the core and coil to the enclosure. On transformers 500 KVA and smaller, the vibration isolation system shall be designed to provide a permanent fastening of the core and coil to the enclosure. To further facilitate vibration and noise isolation, the final section of conduit to the transformer shall be flexible.

5. Transformers 25 KVA and larger shall be in heavy gauge, sheet steel, ventilated enclosures. The ventilating openings shall be designed to prevent accidental access to live parts in accordance with UL, NEMA, and National Electrical Code Standards for ventilated enclosures. Transformers 25 KVA through 75 KVA shall be designed so they can either be floor or wall mounted. Above 75 KVA they shall be of the floor mounted design.
6. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed, and finished in the same color as the motor control equipment. For more details see Division 9 of these Specifications.
7. The maximum temperature of the top of the enclosure shall not exceed 50 degrees Celsius rise above a 40 degrees Celsius ambient.
8. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with NEMA and NEC Standards.
9. The transformer shall be marked "DANGER HIGH VOLTAGE" with labels specified in the section on marking, this Division.
10. The transformers shall be manufactured to requirements of applicable standards, especially as they apply to noise level and surface temperatures.
11. The transformers efficiency shall be DOE 2016 compliant.

B. Pad-mount Oil Filled Transformer

1. General
 - a. Oil type transformers shall not make use of oil containing PCB.
2. Pad-mounted, Tamper-proof, Compartmental Type, Mineral Oil Insulated, Self-cooled Transformer
 - a. The transformer shall be compartmental type, self-cooled, tamper-resistant and weather protected. The transformer shall have a bolted cover with tamper-resistant fastenings. Lifting eyes and jacking pads shall be provided. The tap changing mechanism shall

be externally operable and for de-energized operation only. The high and low voltage compartments shall be side by side, separated by a steel barrier with the low voltage on the right. Access to the high voltage compartment cannot be made until the low voltage door has been opened. Doors shall be equipped with lift-off stainless steel hinges and door stops.

- b. A removable front sill will allow the transformer to be rolled or skidded. High voltage terminations shall be deadfront-externally clamped one piece integral bushings for loop feed operation. Low voltage bushings shall be molded epoxy with blade type spades. The transformer shall comply with the latest applicable standards of NEMA and ANSI.

- c. Additional characteristics and optional features:

Primary Voltage: 12470, Delta
Taps: + 2 - 2 1/2 percent
BIL: 95
Impedance: 4 - 5 percent
Efficiency: DOE 2016 or better
Temperature Rise: 55°C/65°C above a 30°C ambient
Coolant: Inhibited Mineral Oil
Fill plug and pressure relief valve
Oil level plug
Lightning arresters, deadfront (elbow type for installation on unused loop feed bushings) distribution class.
Fusing: ELSP partial range current limiting with expulsion bayonet
No load tap changer: Externally operable
Drain valve and sampling device
Gang operated load break switch (under oil)
Paint: Manufacturer's standard
Windings: Copper
Accessories Required: Thermometer, liquid level gauge

- d. Concrete pad details are shown on the Contract Drawings. Should the transformer offered not fit on the designed pad, cost of modifications and larger pad shall be borne by the Contractor.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

- A. Transformers shall be rigidly mounted to the structure or the foundation in the case of freestanding units.
- B. Transformers shall be megger tested prior to energization.

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- C. Transformers with taps shall be adjusted to supply the nominal service voltage required on the secondary.
- D. Transformers shall be installed in accordance with NEC requirements and manufacturer recommendations.
- E. Ground secondary of transformer per NEC requirements.

END OF SECTION

SECTION 16495

SWITCHBOARD MATTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Switchboard matting shall be furnished by the Contractor and placed in front of the medium voltage switchgear and ATS.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Switchboard matting shall be W.H. Salisbury & Company, Safety Line, Inc., Tepromark, Wearwell, Erico, or equal.

2.02 MATERIALS

- A. Switchboard matting shall be nonconductive with a minimum of 40,000 volts dielectric strength. The mat shall have a corrugated, non-slip surface and shall be a minimum of 1/4 inch thick. Width shall be 36 inches and length shall be as required at each location. The mat shall be black in color, ozone and oil resistant, and manufactured to meet all applicable ANSI/ASTM standards.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

SECTION 16496

BYPASS/ISOLATION AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 SCOPE

- A. The following specifications cover the requirements for providing a complete freestanding assembly containing circuit breakers and control devices for automatic transfer. Furnish the automatic transfer switchgear (ATS) arranged for operation with a 12,470 volt, 3 phase, 3 wire, 60 Hertz, normal and emergency source, with a control system for automatic transfer of the circuit breakers.
- B. Furnish all equipment as described in this section of the specification. All equipment shall have a practical lay-out, consistent with good engineering design practices and allow for future expansion capability.
- C. Factory testing and comprehensive system start-up and site testing is required by authorized manufacturer representative.
- D. The equipment proposed under these specifications shall be compatible with the space provisions and wiring configurations shown on the Contract Drawings.

1.02 RELATED WORK

- A. 16010 - General Electrical Requirements
- B. 16230 - Standby Power Generator System

1.03 SUBMITTALS

- A. Submit shop drawings showing complete dimensions, wiring diagrams, and installation instructions. No equipment shall be manufactured until shop drawings are approved by the Engineer.
- B. Submit test and startup reports.

1.04 APPLICABLE CODES AND STANDARDS

- A. The design, equipment, installation and testing shall be in strict accordance with the applicable requirements set forth in ANSI, UL, IEEE and NEMA.
- B. Due to the critical nature of this facility and to provide for maximum reliability and responsibility, the entire ATS medium voltage circuit breaker transfer switchgear, including all controls, breakers, bus-work and components shall be completely manufactured and assembled by a single manufacturer. The switchgear and controls shall be UL listed and labeled under manufacturer's name at the time of the bid opening. Manufacturers not listed and labeled by UL under "Circuit Breakers and Metal-Clad Switchgear over 600 Volts (DLAH)", at

the time of bid opening, shall not be acceptable. The generator switchgear construction, including all internal components mounted, shall be UL listed and labeled with a bus withstand rating of 500 MVA.

C. All equipment and material supplied shall be in accordance with the latest edition and amendments of all applicable standard, codes, laws and regulations listed below:

1. ANSI/IEEE C12 - Code for Electric Metering
2. ANSI C37.04 - Standard Rating Structure for A.C. High Voltage Circuit Breaker Rated on Symmetrical Current Basis.
3. ANSI C37.06 - Preferred Ratings and Related Required Capabilities for A.C. High Voltage Circuit Breaker Rated on a Symmetrical current Basis
4. ANSI C37.11 - Requirements for Electrical Control for A.C. High Voltage Circuit Breaker Rated on a Symmetrical Current Basis or a Total Current Basis
5. ANSI C37.12 - Guide to Specifications for A.C. High Voltage Circuit Breaker Rated on a Symmetrical Current Basis or a Total Current Basis
6. ANSI C37.20 - Standard for Switchgear Assemblies Including Metal-Enclosed Bus
7. ANSI/IEEE C39.1 - Requirements for Electrical Analog Indicating
8. ANSI C57.13 - Requirements for Instrument Transformers
9. ANSI 255.1 - Gray Finishes for Industrial Apparatus and Equipment
10. ANSI 48 - Test Procedures and Requirements for High-Voltage A.C. Cable Terminations
11. NFPA 70 - National Electric Code
12. NFPA 110 - Emergency and Standby Systems
13. National Electrical Code (NEC)
14. Underwriters' Laboratories, Inc. (UL)
15. National Electrical Manufacturers' Association (NEMA)
16. Federal, State and local Codes

1.05 1.05 WARRANTY

A. The Manufacturer shall provide a complete two-year warranty dating from startup. Any failure to comply with the Contract documents or any defects that

appear within the 2-year period from date of shipment shall be corrected at no cost to the OWNER.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The medium voltage automatic transfer switch shall be manufactured in the United States of America, and shall be RTS series as supplied by base-bid manufacturer Russelectric, Inc. See the bid form to write in an alternate manufacturer with reduced cost. Acceptable alternates include Eaton and Schneider.

2.02 GENERAL

- A. The freestanding metal-clad automatic transfer switchgear shall be designed, assembled and tested in strict accordance with the applicable standards of ANSI, IEEE, NEMA and UL-1670. It shall be arranged for fully automatic or manual operation at the discretion of the operator by the actuation of a master control switch with manual/automatic positions. It shall include draw-out power circuit breakers and the necessary control switches, pilot lights and accessories as specified herein.

2.03 SYSTEM OPERATION

- A. The transfer switch shall be designed to transfer load between two sources, as follows:

Source 1	Utility
Source 2	Generator

- B. When the voltage on any phase of Source 1 is outside of the acceptable parameters, as defined later in this specification, and after a programmable time delay period to allow for momentary voltage dips, the controller shall initiate the open transition transfer to source 2.
- C. The Transfer is accomplished by opening the Source 1 Circuit Breaker and then, after an adjustable time delay, closing the Source 2 Circuit Breaker.
- D. After restoration of Source 1 voltage and frequency on all phases, an adjustable time delay shall delay the retransfer to Source 1 to assure stabilization of that source. After expiration of that time delay period, the transfer switch shall retransfer to Source 1 by opening the Source 2 Circuit Breaker and then , after an adjustable time delay, closing the Source 1 Circuit breaker. Should Source 2 fail anytime during the retransfer time delay period, the transfer switch shall bypass the time delay and immediately initiate retransfer to an available Source 1.

2.04 CONSTRUCTION

- A. The switchgear shall consist of metal enclosed units and auxiliary compartments characterized by the following:
 - 1. All components shall be completely enclosed with grounded metal enclosures.
 - 2. Secondary control devices and their wiring shall be isolated by grounded metal barriers from all high voltage primary devices.
 - 3. Major components of the primary circuits such as circuit breakers, transformers, and buses shall be isolated by grounded metal barriers.
 - 4. The circuit breakers shall be of the draw-out type.
 - 5. Interlocks shall be provided for proper sequencing and safe operation.
 - 6. Buses, connections and joints shall be insulated throughout.
- B. All metal barriers shall be completely grounded. Sheet steel inner-unit barriers shall extend the full height and depth of the unit for isolating each unit from adjacent units. The stationary elements shall be equipped with a ground bus which shall extend through the complete switchgear line-up.
- C. Counter balanced shutters shall automatically close the openings of the cubicle primary disconnects when the circuit breaker is withdrawn from its connected position. The protective shutters shall guard against accidental human contact with the cubicle primary disconnect members. They shall also keep foreign matter from entering the disconnect chambers. Shutters shall be designed to remain closed until the movable primary disconnects on the breaker are in position to enter the cubicle disconnect chambers.
- D. The primary circuit between the circuit breaker and the cubicle shall be made by sets of silver-plated finger contacts which shall engage with silver-plated, solid, cylindrical contacts. The primary disconnect contacts, mounted on the ends of the breaker bussing, shall be of the multiple finger type and shall be compression-spring loaded. The multiple finger arrangement shall offer a large number of contact points which shall be self-aligning. This shall facilitate proper match-up between the removable breaker and the stationary cubicle. These breaker finger assemblies shall be removed when the breaker is withdrawn and shall be available for inspection without the need of de-energizing the main switchgear bus.
- E. The cubicle contact members inside the insulator assemblies shall be recessed and shielded to prevent accidental contact.
- F. The movable secondary control contacts mounted on the breaker shall be self-aligning, line-contact, slip-type connectors. The multiple finger type arrangement on the breaker shall contact with a stationary mounted element.

- G. The contact surfaces on the stationary element shall be recessed to prevent accidental short-circuiting of the control circuits.
- H. Mechanical stops shall prevent over-travel and shall avoid damage to the disconnecting devices when the circuit breaker is levered into operating position.
- I. Breakers shall have stored-energy closing feature. Racking mechanism shall be operable from a standoff position. Positive stops shall be provided to prevent over-travel and guides furnished to insure proper alignment. Suitable cell switches shall be furnished to provide the breaker green light and amber limit light circuits when the breaker is racked out of the cubicle or in the disconnected position. Provide two auxiliary switches for remote indication and/or alarm on breaker position. Mechanical and electrical interlocks shall be provided to prevent removal of the breaker in the closed position and operation of the breaker in an intermediate position.
- J. Provide a two-position "Automatic-Manual" switch to permit operation and testing as follows:
 - 1. In the "Automatic" position, all functions shall perform in the sequence as specified hereinafter.
 - 2. In the "Manual" position, all automatic functions shall be locked out and the opening and closing of the breakers may be manually performed.
- K. Coordinate the functions and circuitry of the various selector switches to insure that the various settings available do not cause malfunction in the intended system operation.
- L. Enclosures to be fabricated from formed channel framework and code gauge sheet steel. All steel parts shall be prepared for painting by a five-step cleaning, phosphatizing and sealing process. The parts shall then be painted ANSI No. 61 Gray, utilizing polyester powder coating applied by the electrostatic method and cured in a baking oven. This finish is suitable for outdoor, as well as indoor, application.

2.05 EQUIPMENT

- A. The Medium Voltage Circuit Breaker transfer switchgear shall consist of the following cubicles:
 - 1. Preferred Utility and Alternate Circuit Breaker Cubicle (quantity of 1), consisting of:
 - 2 - 15KV class vacuum circuit breakers, 3 phase, 1200 amperes, stored energy, draw-out type, arranged for operation on A.C. control power with a 500 mva, 3 phase, interrupting rating. The power circuit breaker shall be provided with an anti-pump relay system and additional auxiliary contacts as necessary for connections to

- the automatic control relay switch and for remote monitoring by synchronizing switchgear.
 - 2 - Sets circuit breaker control switches with red and green position lights
 - 1 - Set 3 phase, 1200 ampere insulated bus and ground bus
 - 1 - Set control wiring, fuses, fuse blocks, terminals, nameplates, etc.
 - 2 - Set compression type lugs for customers' utility source and generator source connections
2. Source 1 Bypass Breaker Cubicle (quantity of 1), consisting of:
- 1 - 15KV class vacuum circuit breakers, 3 phase, 1200 amperes, stored energy, draw-out type, arranged for operation on A.C. control power with a 500 mva, 3 phase, interrupting rating. The power circuit breaker shall be provided with an anti-pump relay system and additional auxiliary contacts as necessary for connections to the automatic control relay switch and for remote monitoring by synchronizing switchgear.
 - 1 - Sets circuit breaker control switches with red and green position lights
 - 1 - Set 3 phase, 1200 ampere insulated bus and ground bus
 - 1 - Set control wiring, fuses, fuse blocks, terminals, nameplates, etc.
 - 1 - Set compression type lugs for customers' utility source and generator source connections
3. Source 2 Bypass Breaker Cubicle (quantity of 1), consisting of:
- 1 - 15KV class vacuum circuit breakers, 3 phase, 1200 amperes, stored energy, draw-out type, arranged for operation on A.C. control power with a 500 mva, 3 phase, interrupting rating. The power circuit breaker shall be provided with an anti-pump relay system and additional auxiliary contacts as necessary for connections to the automatic control relay switch and for remote monitoring by synchronizing switchgear.
 - 1 - Sets circuit breaker control switches with red and green position lights
 - 1 - Set 3 phase, 1200 ampere insulated bus and ground bus
 - 1 - Set control wiring, fuses, fuse blocks, terminals, nameplates, etc.
 - 1 - Set compression type lugs for customers' utility source and generator source connections
4. Load Output and Control Cubicle (quantity of 1), consisting of:
- 1 - Russelectric Model RPTCS, microprocessor automatic transfer control for utility and generator sensing and control of main and emergency circuit breakers. Processor shall be able to accept load control signals (block transfer and load shed), and remote load test from synchronizing switchgear.
 - 1 - Set pilot lights showing the transfer switch in the normal or emergency position

- 2 - Sets of potential transformers, ratio as required, draw-out type, complete with current limiting primary fuses and low voltage secondary fuses, one potential transformer for the generator, two potential transformers for the utility
 - 1 - Load test switch to simulate a normal power failure and test the emergency generator under load
 - 1 - Master control switch with a manual/automatic nameplate
 - 1 - Set 3 phase insulated bus and ground bus
 - 1 - Set control wiring, fuses, fuse blocks, terminals, nameplates, etc.
 - 1 - Set compression type lugs for customers' load connections
- B. The cubicle shall include an RPTCS microprocessor controller.
- C. The transfer switch shall be equipped with a Microprocessor Controller with a Power Supply Module, CPU and I/O Modules. The Microprocessor shall be identical for all voltage and ampere ratings. The controller shall be capable of Ethernet communications.
- D. The controller shall contain voltage sensing modules capable of three phase sensing of each source. The Power Supply Module shall accept a 24 VDC external power source allowing controller communications in the event of a power outage. The transfer switchgear shall include provisions to convert the station battery available voltage to 24V DC for purposes of maintaining power to the transfer controls at all times.
- E. Voltage sensing shall be true RMS type and accurate to +/- 1% of nominal voltage. Frequency sensing shall be accurate to +/- 0.05Hz. The operating temperature range shall be -20 to +50 degrees C and storage from -40 to +90 C.
- F. The controller shall connect to the transfer switch through an interconnecting wiring harness. Interfacing relays shall be provided to isolate the controller from abnormal voltages applied to any and all customer input and output wiring terminals.
- G. All customer interface connections shall be wired to a common DIN rail Cage Clamp terminal block. Sufficient space shall be provided to allow for future modifications and upgrades.
- H. The controller shall meet or exceed the requirements for Electromagnetic Compatibility as follows:
- 1. EN55022 (CISPR11) Conducted and Radiated emissions, Class B
 - 2. EN61000-4-2 (Level 4) ESD immunity test
 - 3. EN61000-4-3 (ENV50140) Radiated RF
 - 4. EN61000-4-4 Electrical fast transient/burst immunity test
 - 5. EN61000-4-5 IEEE C62.41 Surge immunity test

6. EN61000-4-6 (ENV50141) Conducted immunity test
7. EN61000-4-11 Voltage dips and interruption immunity
8. IEEE 472 (ANSI C37.90A) Ring wave immunity

I. Controller Display and Keypad

1. A color, $\frac{1}{4}$ VGA minimum, graphical display shall be provided for viewing data and setting operational parameters. Parameters shall also be available for viewing remotely and limited control through a front accessible USB communications port. All programming functions shall be pass code protected. All programming functions shall be pass code protected.
2. The Controller shall provide high intensity LED's for the following:
 - a. Source Availability - Indicates the source voltage and frequency are within pre-set parameters.
 - b. Source Connected - Indicates the source main contacts closed and the load being served from the source.
 - c. XFER Inhibit - Indicates that the ATS is being inhibited from automatic operation to the unconnected source.
 - d. Alarm: Indicates an alarm condition is active.
 - e. TD Active: Indicates that a transfer switch time delay is actively timing.
3. For ease of navigation, the display shall include the following:
 - a. Soft Keys - Change function based on user location in the menu structure.
 - b. Dedicated Navigational Keys - Home, Scroll Up, End, Escape and Enter.
 - c. Dedicated Pushbuttons for Alarm Reset, Test, Control and Information.

J. Voltage, Frequency and Phase Rotation Sensing

1. The transfer switch controller has programmable voltage and frequency sensing of both Source 1 and Source 2, and shall be capable of detecting a single or three phase losses. The Controller shall have adjustable pickup and dropout settings for each source. Set point ranges for both Source 1 and Source 2 shall be as follows:

Parameter	Drop-out/Trip	Pick-up/Reset
Under-voltage	72 to 100%	70 to 98%
Over-voltage	100 to 108%	102 to 110%
Under-frequency	45.1 to 60.0 Hz	45.0 to 59.9%
Over-frequency	50.0 to 69.7 Hz	50.1 to 69.8 Hz

2. The controller shall monitor phase rotation of both sources and inhibit transfer if both sources are not the same phase rotation. Source rotation shall be field selectable as either ABC or CBA.
3. Settings shall be adjustable in 1% increments either through the keypad, USB port or remotely via communications.
4. A single source status screen shall be provided to allow for viewing of the status of both sources including three phase voltage, power and frequency.

K. Time Delays: The transfer switch controller shall provide the following time delays:

1. The controller shall include an adjustable time delay of 0 to 10 seconds to momentarily override Source 1 power outages.
2. The controller shall include an adjustable 0 to 60 minute time delay on transfer to Source 2, factory set at 3 seconds.
3. The controller shall include a time delay on retransfer to the preferred source adjustable 0 to 259 minutes, factory set at 5 minutes.
4. All time delays shall be adjustable in 1 second increments. All time delays shall be adjustable via the graphical display, the front USB port or configuration software using the USB, serial or Ethernet communications port.

2.06 ADDITIONAL REQUIRED FEATURES AND ACCESSORIES

- A. Test Switch – The controller shall be provided with a two position, password protected, test switch to simulate a Source 1 failure. The test mode shall be configurable for Test Without Load or Test With Load functionality. The Test function shall be activated via the pushbutton on the display or remotely via a dry contact, voltage signal or a network signal.
- B. Engine Start Signal – A SPDT contact, rated 10 amps at 30 VDC, shall be provided to start the engine generator in the event of a Source 1 outage or customer initiated test.

- C. Source connected contacts rated 10 amps at 120 VAC shall be provided to signal when the ATS is connected to each source. Provide a quantity of two contacts for ATS in Source 1 position and two for ATS in Source 2 position each ATS position.
- D. Source Connected LED's - The controller shall include LED's to indicate when the ATS is connected to each source.
- E. Source Availability LED's and Contacts - The controller shall include LED's to indicate the availability of each source. In addition, two voltage free form "C" contacts shall be provided to indicate availability of Source 1, and two voltage free form "C" contacts shall be provided to indicate availability of Source 2. The lights and relays shall provide true source availability indication, as determined by the voltage sensing settings for each source.
- F. Inhibit Transfer Signals - The controller shall be capable of accepting transfer control inputs that inhibit transfer of the ATS to either source for load control purposes for use with generator control switchgear.
- G. Auto/Manual Selector - The controller shall include a programmable function to select either Automatic or Manual operation.
- H. ATS/Engine Exerciser: The controller shall include a user configurable exerciser. Exerciser shall be configurable for daily, 7 day, 14 day or 28 day exercise periods, each with (7) programmable events. The exerciser shall also be configurable as a full, 365 day exerciser with up to 24 independent exercise events. Each event shall be configurable for Test with Load and Test Without Load. Each event shall include user adjustable start time, date and test duration. All time and date settings shall be stored in non-volatile EEPROM memory. The controller shall include full programmability for daylight savings time.
- I. Diagnostics: The controller shall contain self and system diagnostic screens for the purpose of detecting and troubleshooting abnormal system events.
- J. Communications Interface: The controller shall be capable of interfacing via Ethernet TCP/IP communications port integral to the controller. All communications parameters (baud rate, parity, IP Address, etc.) shall be accessible and programmable via the front keypad. Ethernet communication shall be *Modbus TCP* protocol.
- K. Event Logger: The controller shall have the ability to log data and to maintain the last 256 events, even in the event of a power failure. Time and date stamping of events will be accurate to 1 ms. Controller shall be capable of synchronizing its date/time setting with a main PC via Network Time Protocol over an Ethernet TCP/IP network connection.
- L. The following events shall be time and date stamped:
 - 1. Last Primary Source Failure

2. Last reason for transfer.
 3. Last transfer to alternate source
 4. Last retransfer to primary source
 5. Time load is without power
 6. Time ATS powered up
 7. Total time on source 1
 8. Total time on source 2
 9. Total number of primary source failures
 10. Total number of transfers
- M. External Power Supply: The controller shall be capable of being connected to an external 24 VDC power supply to permit full operation and communications of the controller when both sources are de-energized.
- N. Auto Load Shed: The controller shall be capable of being programmed to automatically shed the connected load in the event of a user configurable under frequency condition.
- O. The ATS shall be provided with optional metering for the parameters listed below. Metering shall be true RMS type, with 1% accuracy for voltage and 0.5% accuracy for currents. The transfer switch shall be provided with solid core current transformers with 5 amp secondary current. CT's shall be wired to a shorting block for safety purposes.
- P. The following meter parameters shall be provided:
1. Phase current: Ia, Ib, Ic, In and average current (Iavg)
 2. Phase voltage: Va, Vb, Vc, Vab, Vac, Vbc
 3. Voltage and Current unbalance
 4. Hz, PF, W, Var, VA
 5. Wh, VAh, VARh
 6. Voltage and Current Harmonics (% THD up to 8th order)
 7. Phase Rotation Sensing
- Q. The ATS shall be capable of monitoring and capturing waveform data in the event of a utility power outage or other user specified event.
1. A total of 10 active channels of waveform capture may be user configured.

2. Each channel shall be capable of capturing up to 256 cycles of waveform information.
 3. Analog channels may be configured for 4, 8, 16 or 32 samples/cycle.
 4. Digital channels shall be configured for 1 sample/cycle.
 5. Waveform data shall be stored in industry standard COMTRADE format for broadest compatibility and ease of downloading to a PC.
- R. The controller shall be capable of logging digital and analog measured parameters and storing the data in non-volatile memory.
- S. The controller shall contain a 10 channel Data Logger. Each channel shall be capable of being configured to monitor a digital on/off or analog measured parameter.
- T. The sampling rate of each channel shall be configurable from 1 cycle to 60 minutes per sample. The data shall be stored in non-volatile memory in a first in, first out method.
- U. Output Alarm Contacts
1. Dry (voltage free) alarm contacts shall be provided to indicate the following:
 - ATS in normal position (Source 1)
 - ATS in emergency position (Source 2)
 - Normal Source (Source 1) Available
 - Emergency Source (Source 2) Available
 - ATS Failure
 2. ATS failure shall be determined by neither circuit breaker being closed after an adjustable period of time.

2.07 MANUAL OPERATION

- A. The circuit breakers shall be provided with circuit breaker control switches to allow for manual, open transition transfer operation.
- B. Interlocking shall be provided to assure break before make operation of the circuit breakers.

2.08 STATION BATTERY

- A. A 48V DC source of power is required. A 48AH Ni-Cd station battery from SAFT, Qty (37) UP1M 48, and a 48VDC battery charger from LaMarche, model A12B shall be supplied by the switchgear supplier on a rack for installation within the room.

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2.09 REMOTE CONTROLLER AND TRANSFER STATION

- A. Provide a remote-mount controller and operator transfer station that will allow Owner personnel to monitor and operate the ATS while standing at a safe distance in accordance with NFPA 70E requirements. The cabinet shall be NEMA 12 and all power and wiring necessary shall be sourced from the ATS.

2.10 DIFFERENTIAL CTS

- A. Provide current transformers and controls to monitor the generator power feeder as close as possible to the genset alternator. Provide generator shut down in the event that a short circuit or ground fault develops in the feed from the generator to ATS.

2.11 ARRESTERS

- A. Provide 6 intermediate class lightning arresters – 3 on the utility feed and 3 on the genset feed. Design, fabrication, testing, and performance of arresters shall comply with IEEE C62.11 and NEMA LA 1.
- B. Arresters shall utilize metal oxide varistor and gapped arrester technologies. The arresters shall be contained within a polymer housing. The arrester shall be designed to be non-fragmenting to provide extra safety to personnel and equipment.

PART 3 EXECUTION

3.01 INSTALLATION AND STARTUP

- A. After fabrication in the switchboard manufacturer's plant, an operational test shall be simulated to check out the entire system before delivery.
- B. The Contractor shall install the ATS circuit breaker transfer switchgear plus all associated external wiring for power and controls in accordance with manufacturer requirements. All rigging required for unloading and installation shall be the responsibility of the Contractor.
- C. After installation by Contractor, the manufacturer shall provide field service engineer to startup and owner training. Startup shall be coordinated with the startup of the generator.
- D. The manufacturer of the automatic transfer switchgear shall maintain a competent service organization that is available for service on a 24-hour basis.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide light fixtures as indicated on the Drawings and as specified herein. The specific characteristics of the light fixtures to be furnished and installed shall be as detailed in the light fixture schedule on the Contract Drawings.

1.02 RELATED WORK

- A. Related Sections: The following sections contain requirements that related to this section.
 - 1. Division 1 - General Requirements
 - 2. Section 16010 - General Electrical Requirements

1.03 SUBMITTALS

- A. General: Submit shop drawings in accordance with Section 16010 General Electrical Requirements and the General and Special Conditions. The lighting submittal shall be complete with all fixtures listed utilizing the same tagging convention as listed in the Light Fixture Schedule on the Drawings. The minimum data for each light fixture shall include complete photometrics, electrical characteristics, construction characteristics, and options clearly highlighted or circled.
- B. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted. Product literature with one or more styles/configurations for a single product shall have a written description of use for each of the styles/configurations represented on the literature.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers are Holophane, Lithonia, Cooper, Hubbell, or equal.

2.02 BALLASTS

- A. **Electronic** ballasts with less than 10% THD (Total Harmonic Distortion) shall be provided with luminaires.
- B. All Luminaires shall be quiet. If a Luminaire develops a noticeable hum within the warranty period, the Luminaire shall be replaced without cost to the Owner.

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2.03 LUMINAIRES

- A. All fixtures shall be delivered complete with suspension and mounting accessories, ballasts, diffusers, reflectors, etc., all wired and assembled. All accessory wiring shall be furnished and installed as shown on the Contract Drawings.
- B. All supports required for luminaires in addition to that furnished under the general building construction shall be furnished and installed by the Contractor.
- C. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

2.04 LAMPS

- A. Color temperature shall be 4000k minimum unless indicated otherwise on the Contract Drawings.
- B. Minimum Color Rendering Index (CRI) shall be 80 unless otherwise indicated.

2.05 LIGHTING CONTACTORS

- A. Contactor shall be NEMA ICS 2, electrically held contactor. Contacts shall be rated 600 volts, 30 amperes, and shall include the number of poles indicated on the Drawings. Coils shall be rated for the voltage indicated on the Drawings. Provide in NEMA 1 enclosure conforming to NEMA ICS 6 unless otherwise indicated. Contactor shall have silver alloy double-break contacts. Provide contactor with hand-off-automatic selector switch. Contactor shall be Square D, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

A. General

- 1. The Contractor shall furnish all light fixtures, lighting equipment, components, hangers, etc., as shown on the Contract Drawings and shall install them at the locations shown on the Contract Drawings.
- 2. Deliver lighting fixture in individually wrapped in factory containers. Stack and store in accordance with manufacturer's instructions.
- 3. All fixtures must be UL labeled and listed.
- 4. Lamps are required in all fixtures, whether indicated in the Schedule or not.

B. Luminaires

1. Mounting heights specified as indicated shall be to bottom of fixture. Coordinate exact mounting of lighting fixture with type, style and pattern of ceiling being installed.
2. Any fixtures damaged prior to final completion shall be replaced by Contractor.
3. Replace lamps in lighting fixture which are observed to be inoperable or noticeably dimmed prior to final completion or within the warranty period.
4. No light fixtures shall be hung or installed until after painting is completed, however, the Contractor shall provide temporary lighting.
5. All fixtures shall be left in a clean condition, free of dirt and defects, and shall be cleaned prior to final completion.

END OF SECTION

SECTION 16670

LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide a lightning protection system for the electrical building. The lightning protection system shall be furnished, installed, and connected as detailed on the Contract Drawings to provide a complete and functional system. Installation and equipment construction shall comply with Lightning Protection Institute Installation Code LPI-175, UL Master Label Code 96A, and NFPA 780.
- B. The Contractor shall provide shop drawings indicating location and installation of equipment for review of the Engineer before beginning installation.
- C. All equipment shall be of the same manufacturer, insofar as possible.
- D. Equipment specified herein supplements actual suppression devices specified in Section 16280.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. "Thompson Lightning Protection, Inc.," "Independent Protection Co., Inc.," "National Lightning Protection, Inc." or equal.

2.02 EQUIPMENT

- A. All equipment used in this installation shall be UL approved and labeled in accordance with UL procedures, with each air terminal bearing an "A" label and all main conductors bearing a "B" label at 10'-0" intervals.
- B. All equipment shall be new, and of design and construction to suit the application where it is used in accordance with accepted industry standards and LPI and UL code requirements and as per manufacturers recommendations.
- C. Downlead conductors from roof to ground shall be copper, of 28 strands, 17 gauge minimum. All main roof conductors shall be aluminum, of 24 strands, 14 gauge minimum.
- D. Air terminals shall be solid, round aluminum bar of ½" minimum diameter, and shall project 10" minimum above the object to be protected.
- E. Air terminal bases shall be of cast aluminum with bolted pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Bases on built-up tar and gravel roofs shall be secured with a proper adhesive and shall have a minimum surface contact area of 18.5 square inches.

- F. Ground rods shall be a minimum of 3/4" in diameter and 10'-0" long. They shall be connected to the system using exothermic welds, Cadweld, or equal.
- G. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be spaced according to LPI and UL code requirements.
- H. Bonding devices, cable splicers and miscellaneous connectors shall be of cast aluminum with bolted pressure connections to cable. Cast or stamped crimp fittings are not acceptable.
- I. Equipment on stacks and chimneys shall be protected from corrosion and sized in accordance with LPI and UL requirements.
- J. All miscellaneous bolts, nuts, and screws shall be stainless steel.
- K. An approved bimetal transition fitting shall be used at the roof level to change from aluminum roof conductor to copper downlead cable.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION/ERECTION

- A. The installation shall be accomplished by an experienced installer listed with Underwriters' Laboratories as qualified and who is also a Certified Master Installer of the LPI or working under the direct supervision of an LPI manufacturer as listed above or his authorized LPI Certified Master Installer representative.
- B. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splices, and bonds with cable downleads routed concealed either directly in the building construction for a new structure or in conduit to ground for an existing structure.
- C. The copper downlead cables shall not be brought directly through the roof. Through roof connectors with solid rods or conduits through pitch pockets shall be utilized for this purpose.
- D. The limitations on areas of usage for aluminum cables and for copper and aluminum materials together as outlined in UL 96A and LPI 175 shall be observed. The lightning protection installer will work with other trades to ensure a correct, neat, and unobtrusive installation.
- E. It shall be the responsibility of the lightning protection installer to assure a sound bond to the metallic main water service and to assure interconnection with other building ground systems, including both telephone and electrical and also to ensure that proper arresters have been installed on the power service.

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- F. Downlead conductors from roof to ground shall be protected from mechanical damage from a point 8 feet above to 1 foot below grade by conduit or other means. Downlead conductors must be installed CONCEALED on all new construction. Surface-mounted conduits/raceways will only be allowed on existing facilities that are being upgraded with lightning protection systems.
- G. The lightning protection installer shall secure and deliver a UL Master Label and LPI System Certification to the Engineer for the Owner upon completion of the installation.
- H. The Contractor shall also submit 2 copies of as built shop drawings, 1 with the UL Master Label Application Form and another with LPI forms 175A and B.
- I. A permanent plate shall be affixed to the protected structure in a prominent location, indicating its UL approval.

END OF SECTION

SECTION 16710

TELECOMMUNICATIONS CABLING AND EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide telecommunications cabling, telecom cabinet, and pathway systems as indicated and as specified herein.
- B. Provide grounding as specified herein and as indicated.

1.02 RELATED WORK

- A. Drawings and General Provisions of this Contract including General and Supplementary Conditions and Division 1 Specifications Sections, apply to work of this Section.
- B. Section 16010 – General Electrical Requirements
- C. Section 16130 - Raceways
- D. Section 16131 – Boxes

1.03 REFERENCES

- A. The publications of the standards organizations listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the organization abbreviation with applicable publication number.
 - 1. ASTM International (ASTM)
 - 2. Electronic Industries Alliance (EIA)
 - 3. Institute of Electrical and Electronics Engineers (IEEE)
 - 4. Insulated Cable Engineers Association (ICEA)
 - 5. National Electrical Manufacturers Association (NEMA)
 - 6. National Fire Protection Association (NFPA)
 - 7. U.S. Federal Communications Commission (FCC)
 - 8. Underwriters Laboratories (UL)
 - 9. U.S. Department of Agriculture (USDA) – (RUS)

1.04 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2, EIA TIA/EIA-568-C.3, EIA TIA/EIA-569-A, EIA TIA/EIA-606-A and IEEE Std 100 and herein.
- B. Open Cable - Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.
- C. Pathway - A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.05 SUBMITTALS

- A. The submittals listed below are required and shall be submitted in accordance with Section 16010. Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references.
- B. Shop Drawings/Product Data (submit prior to procurement/installation)
 - 1. Product data - Shall include telecommunications cabling, patch panels, telecommunications outlet/connector assemblies, connector blocks, cabinet, and all other equipment to be installed.
 - 2. Manufacturer Test Reports - Shall include manufacturer's factory reel test.
 - 3. Certificates - Shall include Telecommunications Contractor qualifications, Key Personnel qualifications, and Manufacturer qualifications
 - 4. Test plan - Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories. Include procedures for certification, validation, and testing.
- C. Operation and Maintenance Manuals (submit when installation is substantially complete)
 - 1. Include operation and maintenance information, including user manuals for all equipment.
 - 2. Include all information in the shop drawing/product data submittal with updated as-built information and drawings.

3. Submit any required telecommunications management software on Compact Disk, along with a backup copy of any electronic databases or files developed during the course of the project.
- D. Test Reports – Submit a binder with report of all testing required by Part 3 of this Section. Each cable shall have an individual test report signed and certified by the tester.

1.06 QUALITY ASSURANCE

- A. Terminations shall be performed by an approved telecommunications contractor and key personnel. Qualifications shall be provided for the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.
- B. Telecommunications Contractor - The Contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The Contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the Contractor.
- C. Key Personnel – The person assigned to the termination of telecom cables on this project shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installer, Installer Level 2 minimum. Submit documentation of current BICSI certification.
- D. Minimum Manufacturer Qualifications - Cabling, equipment and hardware manufacturers shall have a minimum of 3 years' experience in the manufacturing, assembly, and factory testing of components which comply with EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2 and EIA TIA/EIA-568-C.3.
- E. Regulatory Requirements - Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.
- F. Standard Products - Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer. Products manufactured more than 3 years prior to date of delivery to site shall not be used.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C (32 to 140 degrees F) and in the range of 0 to 95 percent relative humidity, noncondensing.

1.08 WARRANTY

- A. The warranty shall comply with the General Conditions of this Contract.

1.09 SPARE PARTS

- A. Furnish one spare Ethernet switch for each unique switch installed.
- B. Furnish one spare power supply for each unique power supply installed.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cabling and Accessories
 - 1. Copper – “Belden,” “Alpha Wire,” “General Cable,” or equal.
 - 2. Fiber – “Corning,” “Belden,” “Alpha Wire,” “General Cable,” or equal.

2.02 COMPONENTS

- A. All components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.03 TELECOMMUNICATIONS PATHWAY

- A. Telecommunications pathways shall all be conduit on this project.
- B. Conduit– See Section 16130 for requirements.

2.04 TELECOMMUNICATIONS CABLING

- A. Cabling shall be UL listed for the application and shall comply with EIA TIA/EIA-568 and NFPA 70. Provide a labeling system for cabling as required by EIA TIA/EIA-606-A and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.
- B. Provide cable in compliance with NFPA 70 and performance characteristics in accordance with EIA TIA/EIA-568-C.1.
 - 1. Copper - Provide copper cable in accordance with EIA TIA/EIA-568-C.2, UL 444, ICEA S-90-661 UTP (unshielded twisted pair), 100 ohm, tested to 350MHz minimum. Provide four each individually twisted pair, 24 AWG conductors, Category 5e, with a blue thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular intervals not to exceed 3 feet. The word "FEET" or the abbreviation "FT" shall appear after each length marking. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.
 - 2. Optical Fiber - Provide optical fiber cable in accordance with EIA TIA/EIA-568-C.3 and EIA TIA/EIA-492AAAB, multimode, 50/125-um diameter, 0.275 numerical aperture, designed for underground use in ducts with minimum 6 fibers. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 40 inches. The cable jacket shall be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with EIA TIA/EIA-598-B.
 - 3. Work Area Cabling and Patch Cables
 - a. Work Area Copper - Provide pre-connectorized work area copper cable and patch cables in accordance with EIA TIA/EIA-568-C.2, with a blue thermoplastic jacket, compliant with same specifications as Horizontal Copper cabling above.
 - b. Work Area Optical Fiber - Provide pre-connectorized optical work area cable and patch cables in accordance with EIA TIA/EIA-568-C.3. Fibers shall be 50/125 um. Connectors shall be ST or SC.

2.05 TELECOM CABINET

- A. Provide connecting hardware and termination equipment in the telecom cabinet for terminating and cross-connecting permanent cabling.
- B. Cabinets, wall-mounted double-hinged type, 16 gauge steel or 11 gauge aluminum construction, minimum, treated to resist corrosion. Cabinet shall have

lockable doors, louvered side panels, ground lug, and top and bottom cable access. Cabinet shall be compatible with 19 inch panel mounting. A surge protected power strip with 6 duplex 20 amp receptacles shall be provided within the cabinet. Cabinet shall be sized for a minimum of 4U of spare rack space.

C. Connector Blocks - Provide insulation displacement connector (IDC) Type 110 for Category 5e systems.

D. Patch Panels - Provide pre-connectorized optical fiber and copper patch cords for patch panels. Provide patch cords, as complete assemblies, with matching connectors as specified. Provide fiber optic patch cables with crossover orientation in accordance with EIA TIA/EIA-568-C.3. Patch cords shall meet minimum performance requirements specified in EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2 and EIA TIA/EIA-568-C.3 for cables, cable length and hardware specified.

1. Modular to 110 Block Patch Panel - Provide in accordance with EIA TIA/EIA-568-C.1 and EIA TIA/EIA-568-C.2. Panels shall be third party verified and shall comply with EIA/TIA Category requirements. Panel shall be constructed of 0.09 inch minimum aluminum and shall be rack mounted. Panel shall provide 24 non-keyed, 8-pin modular ports, wired to T568B. Patch panels shall terminate the building cabling on Type 110 IDCs and shall utilize a printed circuit board interface. The rear of each panel shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port.

2. Fiber Optic Patch Panel - Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of 16 gauge steel or 11 gauge aluminum minimum and shall be rack mounted and compatible with a EIA-310-D 19 inch equipment rack. Each panel shall provide 12 multimode adapters either SC or ST. Provide dust cover for unused adapters. The rear of each panel shall have a cable management tray a minimum of 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

E. Uninterruptible Power Supply (UPS)

1. The UPS shall be an American Power Conversions (APC), Liebert, or equal. It shall be rack-mount type.
2. The supply voltage shall be capable of 120VAC +/- 23%.
3. The UPS shall be capable of operating properly within a frequency range of 60 Hz +/- 3%.
4. Operating Ambient Temperature Range: 32 to 104 F minimum.
5. The UPS shall have an output rating of at least 150% of the load to be served, but shall not be less than 420VA. It shall be sized for 30-minute minimum backup power.

6. The UPS shall provide 120VAC output voltage with voltage regulation within +/- 4% for both normal and battery operation.
7. The UPS shall be equipped with circuitry to protect itself from overloads and short-circuits.
8. The UPS shall be able to withstand 110% overload for at least 5 minutes.
9. The UPS shall have a maximum transient recovery time of 30 milliseconds.
10. The UPS shall maintain a battery recharge rate designed to prolong battery life. The battery charger shall maintain a constant voltage and current charge and maintain the battery in a fully charged state. Recharge time shall be 3 hours maximum to 95% capacity after discharge into a full load.

F. Ethernet Switch – Managed POE

1. The Ethernet switch shall be IEEE 802.3 compliant. It shall be Cisco Small Business series, or equal, with Fiber optic ports. Provide appropriate fiber optic media converter and patch cable.
2. Port Densities: Provide a 24 port switch
3. Port Configurations: All switches shall be Copper 10/100/1000TX with RJ-45 connections.
4. Auto-negotiation: All Copper TX ports shall support auto negotiation. Each TX port will be able to interface to 10/100/1000 meg or full/half duplex devices.
5. AutoCross: All TX ports will provide cable autocross capability.
6. The address table shall have a minimum capacity of 4000 addresses.
7. The switch shall also have power supply, link active, and communications status LEDs
8. The switch shall be powered by 120VAC. Provide power supply adapter if needed.
9. The Switch shall have an operating temperature range of 0° to 50° C or greater
10. The switch shall withstand a maximum continuous operating humidity of 95% without condensation.
11. The switch shall be the managed type and shall support VLANs. It shall have POE output power capability.

2.06 MEDIA CONVERTER

- A. Provide appropriate media converter for installation in the filter building, to work with the media converter installed in the electrical building telecom rack.

2.07 GROUNDING AND BONDING PRODUCTS

- A. Provide in accordance with UL 467, TIA J-STD-607-A, and NFPA 70. Components shall be identified as required by EIA TIA/EIA-606-A

2.08 FIELD FABRICATED NAMEPLATES

- A. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick,

white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.09 TESTS, INSPECTIONS, AND VERIFICATIONS

- A. Factory Reel Tests - Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.3, and EIA TIA/EIA-526-14A for multimode optical fiber cables.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2, EIA TIA/EIA-568-C.3, EIA TIA/EIA-569-A, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Sections 16130 and 16131. All cable should be installed in a neat and workmanlike manner.
- B. Cabling - Install UTP and optical fiber telecommunications cabling system as detailed in EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2, EIA TIA/EIA-568-C.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry. Provide service loop on each end of the cable, 3 feet in the telecom cabinet. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.
- C. Pathway Installations - Provide in accordance with EIA TIA/EIA-569-A and NFPA 70. Provide building pathways as specified herein and in Section 16130.
- D. Cabinet Termination - Install termination hardware required for Category 5e and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.
 - 1. Connector Blocks - Connector blocks shall be rack mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with EIA TIA/EIA-569-A.

2. Patch Panels

- a. Copper Patch Panel - Copper cable entering a patch panel shall be secured to the panel with cable ties or as recommended by the manufacturer to prevent movement of the cable.
 - b. Fiber Optic Patch Panel - Fiber optic cable loop shall be 3 feet in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.
- E. Electrical Penetrations - Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 16010.
- F. Grounding and Bonding - Provide in accordance with TIA J-STD-607-A and NFPA 70. Provide a #4 AWG insulated isolated ground conductor from the service entrance ground point to the telecom rack where terminal equipment is to be located. The Contractor shall be responsible for this installation, and the conductor shall terminate on an isolated ground bus, 12 inches in length, equal in capacity to the #2 conductor.

3.02 LABELING

- A. Labels - Provide labeling in accordance with EIA TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process (such as a Brady labeler) or a laser printer.
- B. Cables shall be labeled using color labels on both ends with identifiers in accordance with EIA TIA/EIA-606-A.
- C. Termination Hardware - Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with EIA TIA/EIA-606-A.

3.03 FIELD FABRICATED NAMEPLATE MOUNTING

- A. Fasten nameplates to the device with a minimum of two stainless steel machine screws or rivets.

3.04 TESTING

- A. Telecommunications Cabling Testing - Perform telecommunications cabling inspection, verification, and performance tests in accordance with EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2, and EIA TIA/EIA-568-C.3 where applicable. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

1. Inspection - Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568B pin assignments, and inspect cabling connections to confirm compliance with EIA TIA/EIA-568-C.1, EIA TIA/EIA-568-C.2, and EIA TIA/EIA-568-C.3. Visually confirm Category 5e marking of outlets, cover plates, outlet/connectors, and patch panels.
2. Verification Tests - UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connected. For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with EIA TIA/EIA-568-C.3 and EIA TIA/EIA-526-14A using Method A, Optical Power Meter and Light Source for multimode optical fiber. Perform verification acceptance tests.
3. Performance Tests - Perform testing for each outlet and MUTOA as follows:
 - a. Perform Category 5e link tests in accordance with EIA TIA/EIA-568-C.1 and EIA TIA/EIA-568-C.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay and delay skew.
 - b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with EIA TIA/EIA-568-C.3.

END OF SECTION

SECTION 16900

SCADA PANEL

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide a SCADA panel (RTU-EB) with PLC as specified herein. Note: Owner will furnish programming of SCADA PLC and existing SCADA software under a separate Contract.

1.02 RELATED WORK

- A. Drawings and General and Supplementary Conditions of the Contract and Division 1 Specifications sections apply to this Section.

1.03 SUBMITTALS

- A. Panel and enclosure plan and elevation drawings depicting all components and wiring duct
- B. Complete wiring diagrams
- C. Catalog cut-sheets on all components, with options clearly indicated and non-applicable items clearly excluded
- D. O&M manuals shall be submitted in accordance with Section 16010. They shall include all field modifications made such that the wiring diagrams exactly match the field-installed equipment and control panels. They shall also include complete cut-sheets, product data, operation, and maintenance information.

1.04 REFERENCES

- A. NFPA 79 – All control panels shall comply with NFPA 79.
- B. NEC – The panel shall comply with NEC article 409.
- C. UL508 – The panel shall be listed to UL508 and shall bear the UL label.

1.05 GENERAL REQUIREMENTS

- A. The panel furnished under this Contract shall be manufactured in accordance with industry standards and as herein specified. The Contractor shall coordinate all subcontractors and vendors to ensure that the panel is furnished and meets the requirements specified herein.
- B. Control panel shall be as manufactured by ControlWorks, Inc., Quality Controls, ADGO, or other UL or ETL qualified panel vendor. Panel construction shall comply with OSHA requirements and shall be either UL or ETL listed.

- C. Control panel to be furnished on this project shall be wired to function according to schematics shown on the Contract Drawings. The panel shall be manufactured using a PLC (Programmable Logic Controller) with I/O as indicated on the Drawings. In addition to the requirements shown on the Contract Drawings, the panels shall adhere to additional requirements as written herein, and in the utilization equipment specifications.
- D. All components shall be mounted with threaded screws to a subpanel inside the enclosure such that they are replaceable without removing the subpanel. All wiring must be stranded and protected by a circuit breaker. Supplementary circuit breakers may be utilized for circuits that require wiring smaller than 14 gauge. Wiring ducts for cable/conductor management are required to be utilized for routing of conductors and cables. Ducts are also required to be provided for field-wiring at the top and bottom of the panels. All field wires should terminate at a terminal strip upon entering the control panel enclosure.
- E. Elementary control schematics and connection diagrams showing the spatial relationship of components and wiring shall be submitted for review. Also, a bill of materials, drawing of device arrangement on front, and enclosure fabrication drawings shall be submitted. Further, descriptive literature is required on all components. A copy of the as-built wiring diagrams and BOM shall be stored in a pocket inside the control panel enclosure.
- F. Labels shall be installed on all wires, keynoted back to the elementary schematic or the connection diagram, and all terminals identified.
- G. Short circuit ampacity: The minimum short circuit ampacity of the control panel shall be 10kA. Provide current-limiting fusing if necessary to meet this criteria.

PART 2 - PRODUCTS

2.01 ENCLOSURES

- A. Control panel enclosure shall be wall-mount type. Enclosure shall include an IEC style rotary lockable disconnect for single phase power supply. Enclosures shall be manufactured by Hoffman, or equal.
- B. Enclosure NEMA rating shall be NEMA 12. The enclosure shall be sized to provide 25% spare panel space located for future PLC I/O modules and din rail terminal blocks. Seams shall be continuously welded and ground smooth.
- C. Enclosure door shall have a 3-point latch. Screw clamps are not acceptable. The latch handle shall have a padlock hasp.
- D. The enclosure shall also have an interior pocket for holding wiring diagrams, and an interior sub-panel for mounting control equipment.

2.02 WIRING REQUIREMENTS

- A. Wire and cable shall comply with Section 16120 except Type MTW conductors shall be used inside the control panel for control circuits. Control circuit wiring shall be 18 gauge or larger.
- B. Control wiring shall be terminated using crimp-type ferrule, fork, or ring terminals. Power wiring shall utilize compression lugs.
- C. Wiring shall extend to terminal blocks for connection to external equipment.

2.03 POWER SUPPLIES

A. DC Power Supply

- 1. DC power supplies shall be switched mode and Din-rail mountable.
- 2. Input power range shall be from 85-264 VAC.
- 3. Output voltage range shall be as needed with a tolerance of 1%. Output voltage shall be adjustable up and down at least 10% from the nominal value.
- 4. The power supply shall include an internal input fuse.
- 5. Power supply shall have a "DC Ok" signaling LED.
- 6. Operating temperature rating shall be -25 C to +70 C and up to 95% relative humidity.
- 7. Output power shall be buffered for full output power ride through for 20 milliseconds in the event of a power outage.
- 8. The power supply shall be able to supply 150% of its continuous capacity for short periods of time.
- 9. The power supply shall have internal short circuit protection with automatic recovery.
- 10. The power supply shall be Phoenix Contact, Sola, Allen-Bradley, or equal.

2.04 OVERCURRENT PROTECTION

- A. Main Single-Phase Breakers – Shall be Din-rail mountable with clear "on," "off," and "tripped" positions, Square D QOU or equal. Where a substantial number of breakers are used, provide a panelboard mounting base.
- B. Supplementary Protectors – Shall be Din-rail mountable UL489 listed. Trip rating shall match load served.

2.05 MISCELLANEOUS PANEL COMPONENTS

A. Terminal Blocks, #10 conductor size and smaller.

1. Terminal blocks shall be Din-rail mountable IEC style with minimum width of 6.2 mm. They shall be rated for conductors from #10 to #24 AWG. Current rating shall be 30A, minimum. Terminal blocks shall be finger-safe. Double level terminal blocks may be utilized where necessary to conserve space.
2. Screw clamp terminal blocks are required. Terminal blocks that rely upon spring pressure only for conductor termination are not acceptable.
3. Provide cross connection bridges, partition plates, end anchors, zack strip labels, and all other components necessary for a complete installation. Each block shall be labeled with a machine-printed label. No more than 2 conductors may be landed under on single terminal block terminal screw.
4. Utilize the following terminal block colors:
 - a. 120V Power – Black
 - b. 120V Control – Red
 - c. 120V Neutral – White
 - d. Equipment Grounding – Green or Green/Yellow
 - e. DC Positive – Blue
 - f. DC Negative/Grounded – Gray
 - g. Conductor energized from remote source: Yellow
5. Terminal blocks shall be manufactured by Phoenix Contact, Allen-Bradley, or equal.

B. Fuse blocks (control circuits) – Fuse blocks shall be finger safe and shall have LED indication when the fuse is blown. Fuses may be used only where indicated on the Drawings; otherwise use circuit breakers.

C. Conductor Labels – Shall be the heat-shrink or self-laminating type, machine printed. Brady, or equal.

D. Component nameplates – Shall be engraved, rigid, laminated plastic with adhesive back and letter height of 3/16" minimum. Nameplates shall be white with black letters.

E. Provide a transient/Surge protector which shall comply with Section 16280.

F. Control Relays

1. Control relays shall be magnetic, general purpose, "ice cube" type with 3-pole (minimum), double throw contacts rated at 5 amperes (minimum), 120 volts (minimum). Coils shall be rated to operate at the indicated control voltage.

2. Provide proper bases, mounting track, etc. for a complete installation. All relays shall have a retainer clip, manual operator, and pilot light. Coils connected to solid-state digital outputs shall have transient surge protection.

G. PLC I/O Interposing Relays

1. Interposing relays shall be Allen-Bradley 700-HL series or equal with 6A single-pole double-throw contact, LED indicator, and built-in transient protection.

2.06 PROGRAMMABLE CONTROLLER (PLC) AND I/O

- A. The compact programmable controller shall be Allen-Bradley CompactLogix, no exceptions. There shall be sufficient I/O points provided to cover all the I/O indicated on the Contract Drawings, plus 20% spare of each type. Spare I/O points shall be wired out to terminal blocks for future use.
- B. The compact programmable controller shall include a chassis, power supply, processor, I/O modules, communications modules, cables, and all other components required to make a complete, functional system.

C. Processor Unit

1. Provide 1769-L33ER or equal.
2. Processor Memory: 2 megabytes, battery backed RAM, minimum
3. Capability of controlling up to (16) local I/O modules
4. Shall have typical throughput Time of 0.08 ms/K based upon a 1K ladder logic program consisting of simple ladder logic and communications servicing.
5. Shall have Bit Execution Time of less than 0.51 microseconds
6. Shall support Proportional Integral Derivative Control with up to 451 microsecond execution time
7. Shall support online programming including runtime editing
8. Memory Back-up provided through minimum two year lithium battery
9. LED indicators including: POWER, RUN, Fault, Network status
10. One USB port
11. Shall support a Real Time Clock
12. The processor shall support Ethernet communications via RJ-45 connection

D. Provide a SD card for non-volatile program storage.

1. Discrete Input Modules
 - a. Provide 16 inputs, minimum.
 - b. Shall include removable terminal block
 - c. Shall include LEDs to indicate the status of each I/O point
 - d. Shall include optical isolation between digital and field circuits
2. Discrete Output Modules
 - a. Shall be either a relay output module with minimum (8) individually isolated outputs, or a transistor output type with minimum (16) outputs and interposing relays provided.
 - b. Shall include removable terminal block
 - c. Shall include LEDs to indicate the status of each I/O point
 - d. Shall include optical isolation between digital and field circuits
3. Analog Input Modules
 - a. Provide minimum 4 isolated input channels per module
 - b. Current Rating of 0 to 20mA, 4 to 20mA
 - c. Minimum resolution of 14 bits
 - d. Input Group to Bus Isolation of 500Vac for (1) minute
 - e. Removable terminal block
 - f. LEDs to indicate the status of each I/O point
4. Analog Output Modules
 - a. Provide minimum 4 isolated output channels per module
 - b. Current Rating of 0 to 20mA, 4 to 20mA
 - c. Shall drive a resistive load of minimum 500 ohms.
 - d. Resolution of 14 bits minimum
 - e. Open and short-circuit protection
 - f. Output voltage protection
 - g. Input Group to Bus Isolation of 500V ac for (1) minute
 - h. Removable terminal block
 - i. LEDs to indicate the status of each I/O point

PART 3 - EXECUTION

3.01 LABELING

- A. Provide labels for all conductors and components.
- B. Legends for starter nameplates shall be taken from the one line diagram in the Contract Drawings. Wire and miscellaneous component labels shall match the O&M manual wiring diagrams.

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3.02 GROUNDING

- A. Enclosures shall be grounded in accordance with the NEC.
- B. Each analog signal loop shall be grounded at a single point for the loop at the location of the DC power supply for the loop.

3.03 PROTECTION

- A. All electrical and electronic components of the Control Panel shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and surges in nearby electrical systems. Provide a surge protection device (SPD).

3.04 INSTALLATION/ERECTION

- A. Equipment furnished under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, manufacturer Shop Drawings, and manufacturer installation instructions.

END OF SECTION
