■ **Professional**

■ **Engineering**

Case No.
2007-00134

■ **Services**

Project
Manual

Contract 1-2007

Franklin County 20 MGD Booster Pump Station and 3 MG Storage Tank

STRAND
ASSOCIATES, INC.®
ENGINEERS

Exhibit C - Specifications

Kentucky-
American Water

February 2007

BIDDING DOCUMENTS

KENTUCKY AMERICAN WATER

FRANKLIN COUNTY 20 MGD BOOSTER PUMP STATION AND 3 MG STORAGE TANK PROJECT

Prepared by:

AMERICAN WATER WORKS SERVICE COMPANY, INC.

2300 RICHMOND ROAD
LEXINGTON, KENTUCKY 40502

FEBRUARY 2007

SECTION 00010

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FRANKLIN COUNTY 20 MGD BOOSTER PUMP STATION
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END OF SECTION

INVITATION TO BID
FOR CONSTRUCTION OF

FRANKLIN COUNTY 20 MGD BOOSTER PUMP STATION
AND 3 MG STORAGE TANK PROJECT

Sealed Bids for furnishing all plant, labor, equipment, materials and performing all Work to construct the Franklin County 20 mgd Booster Pump Station and 3 mg Storage Tank Project, will be received and opened at the office of the Kentucky-American Water Company, 2300 Richmond Road, Lexington, KY 40502 at 2:00 p.m., local time, **(date of bid opening)**.

Two (2) sets of Bidding Documents, including the Instructions to Bidders, Bid Form, Bid Bond Forms and Contract Documents, will be provided at no charge to the CONTRACTORS who are invited to bid the project. Additional copies can be obtained from Strand Associates, Inc., at the following address: 325 W. Main Street, Suite 710, Louisville, KY 40202 for a fixed charge of (**$_____**) per set.

Requests for complete sets shall be forwarded to the above address and shall be accompanied by a check in the proper amount. Checks shall be made payable to Strand Associates, Inc. Checks shall be non-refundable and no refunds will be made for return of complete or partial Contract Documents.

Subcontractors, manufacturers and material suppliers should obtain information and review the Bidding Documents by contacting potential Bidders. Documents will also be available for review at the Kentucky-American Water or the office of Strand Associates, Inc.

Each proposal shall be accompanied by a Bid Bond in an amount not less than ten (10%) percent of the bid total, payable to the OWNER, all in accordance with the provisions contained in the Bidding Documents.

OWNER reserves its rights to waive any informality or deficiency in any Bid, to accept any Bid, to negotiate modifications of any Bid with any Bidder and accept any modified Bid, to reject any Bid, to reject all Bids, and to rebid the Project, all at the OWNER's sole discretion.

INSTRUCTIONS TO BIDDERS

1. Defined Terms

Terms used in these Instructions to Bidders which are defined in the General Conditions of the Contract Documents have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to OWNER, as distinct from a subbidder, who submits a Bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Invitation to Bid, Instructions to Bidders, the Bid Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

2. Copies of Bidding Documents

2.1 Complete sets of the Bidding Documents in the number and for the amount, if any, stated in the Invitation to Bid may be obtained from the party listed on the Invitation to Bid. No refunds will be made for the return of complete or partial copies of the Bidding Documents.

2.2 Complete sets of Bidding Documents must be used in preparing Bids; neither OWNER nor ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

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

3. Qualifications of Bidders

Bidders must be prequalified. Each Bid must contain evidence of Bidder's qualification to do business in the state where the project is located or covenant to obtain such qualification prior to award of the contract.

4. Examination of Contract Documents and Site

4.1 It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work, (c) consider Laws and Regulations that may affect cost, progress, performance or furnishing of the Work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify ENGINEER of all conflicts, errors or discrepancies in the Contract Documents.

4.2 Reference is made to the Supplementary Conditions for identification of:

4.2.1 those reports of explorations and tests of subsurface conditions at the site which have been utilized by ENGINEER in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical data contained in such reports but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.

4.2.2 those drawings of physical conditions in or relating to existing surface and subsurface conditions (except Underground Facilities) which are at or contiguous to the site which have been utilized by ENGINEER in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical

data contained in such drawings but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the purpose of bidding or construction.

Copies of such reports and drawings will be made available by OWNER to any Bidder on request. Those reports and drawings are not part of the Contract Documents.

4.3 Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to OWNER and ENGINEER by owners of such Underground Facilities or others, and OWNER does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

4.4 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Paragraphs 4.2 and 4.3 of the General Conditions.

4.5 Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

4.6 On request in advance and after submittal of Bidder's evidence of insurance coverage meeting limits designated in the Supplementary Conditions, OWNER will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up and restore the site to its former condition upon completion of such explorations.

4.7 The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by CONTRACTOR. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by OWNER unless otherwise provided in the Contract Documents.

4.8 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. Interpretations and Addenda

5.1 All questions about the meaning or intent of the Contract Documents are to be directed to ENGINEER. 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 formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

5.2 Addenda may also be issued to modify the Bidding Documents as deemed advisable by OWNER or ENGINEER.

6. Bid Security

6.1 Each Bid must be accompanied by Bid security made payable to OWNER in an amount of ten percent of the Bidder's maximum Bid price and in the form of a Bid Bond (on form attached), issued by a surety meeting the requirements of Paragraph 5.1 of the General Conditions.

6.2 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen days after the Notice of Award, OWNER may annul the Notice of Award and 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 expiration of the period that bids are subject to acceptance, whereupon Bid security furnished by such Bidders will be returned. Bid security with Bids which are not competitive will be returned within Fourteen days after the Bid opening.

7. Contract Times

The times for Substantial Completion and final completion are to be set forth by Bidder in the Bid and will be included in the Agreement. The times will be taken into consideration by OWNER during the evaluation of Bids, and it will be necessary for the Successful Bidder to satisfy OWNER of Bidder's ability to achieve Substantial Completion and final completion within the times designated in the Bid. Substantial Completion is desired on or before **********.

8. Liquidated Damages

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

9. Substitute and "Or-Equal" Items

Substitute or "Or-Equal" items are subject to the requirements of Paragraph 6.7 of the General Conditions.

All Bids shall be based upon the specified products. However, Bidders are encouraged to quote on alternative products by listing them in the tabulation of "Alternative Equipment and/or Materials" of the Bid Form. No later substitutes will be considered by the OWNER.

The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities which alternatives must meet to be considered acceptable. The burden of proof of equality rests with the Bidder and adequate supporting information must be provided. The OWNER reserves the right to accept or reject proposed alternatives.

The Bid sum for each proposed alternative shall include all money required to incorporate the alternative into the project. Later requests for additional monies for alternatives will not be considered.

10. Subcontractors, Suppliers and Others

10.1 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers and other persons and organizations (including those who are to furnish the principal items of material and equipment)

to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within seven days after the Bid opening submit to OWNER a list of all such Subcontractors, Suppliers and other persons and organizations proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent organization information if requested by OWNER. If OWNER or ENGINEER after due investigation has reasonable objection to any proposed Subcontractor, Supplier, other person or organization, OWNER or ENGINEER may before the Notice of Award is given request the apparent Successful Bidder to submit an acceptable substitute without an increase in Bid price.

If apparent Successful Bidder declines to make any such substitution, OWNER may award the contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the Bid security of any Bidder. Any Subcontractor, Supplier, other person or organization listed and to whom OWNER or ENGINEER does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.8.2 of the General Conditions.

10.2 No CONTRACTOR shall be required to employ any Subcontractor, Supplier, other person or organization against whom CONTRACTOR has reasonable objection.

11. Bid Form

11.1 The Bid Form is included with the Bidding Documents; additional copies may be obtained from the party issuing the documents as listed on the Invitation to Bid.

11.2 All blanks on the Bid Form must be completed in ink or by typewriter.

11.3 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.

11.4 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

11.5 All names must be typed or printed below the signature.

11.6 The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).

11.7 The address and telephone number for communications regarding the Bid must be shown.

12. Submission of Bids

Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

13. Modification and Withdrawal of Bids

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

14. Opening of Bids

The opening of Bids will be private.

15. Bids to Remain Subject to Acceptance

All Bids will remain subject to acceptance for **90** days after the day of the Bid opening, but OWNER may, in its sole discretion, release any Bid and return the Bid security prior to the acceptance period.

16. Award of Contract

16.1 OWNER reserves the right to reject any and all Bids, to waive any and all informalities and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, nonresponsive, unbalanced or conditional Bids. Also, OWNER reserves the right to reject the Bid of any Bidder if OWNER believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by OWNER. Discrepancies in the multiplication of units of Work and Unit Prices will be resolved in favor of the Unit Prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

16.2 In evaluating Bids, OWNER will consider the qualifications of the Bidders, 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.

16.3 OWNER may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. OWNER also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

16.4 OWNER may conduct such investigations as OWNER deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to OWNER's satisfaction within the prescribed time.

16.5 If the contract is to be awarded, it will be awarded to the lowest Bidder whose evaluation by OWNER indicates to OWNER that the award will be in the best interests of the Project.

16.6 If the contract is to be awarded, OWNER will give the Successful Bidder a Notice of Award within the period of time that bids are subject to acceptance.

17. Contract Security

Paragraph 5.1 of the General Conditions and the Supplementary Conditions set forth OWNER's requirements as to performance, payment, or other Bonds. When the Successful Bidder delivers the executed Agreement to OWNER, it must be accompanied by the required Bonds.

18. Signing of Agreement

When OWNER gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within fifteen days thereafter CONTRACTOR shall sign and deliver the required number of counterparts of the Agreement and attached documents to OWNER with the required Bonds. Within ten days thereafter OWNER shall deliver one fully signed counterpart to CONTRACTOR.

19. Prebid Conference

A prebid conference will be held at _*_ a.m. on the _*_ day of _*_ at _*_. Representatives of OWNER and ENGINEER will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. ENGINEER will transmit to all prospective Bidders of record such Addenda as ENGINEER considers necessary in response to questions arising at the conference.

20. Sales and Use Taxes

OWNER is not exempt from State Sales and Use Taxes on certain materials and equipment to be incorporated in the Work. Said taxes shall be included in the Contract Price. Refer to Supplementary Conditions SC-6.15 for additional information.

21. Retainage

Provisions concerning retainage are set forth in the Agreement.

20

BID

PROJECT IDENTIFICATION: **Franklin County, Kentucky**
20 mgd Booster Pump Station and 3 mg Storage Tank

THIS BID IS SUBMITTED TO: **Nick Rowe, President**
ATTN: Michael Galavotti, P.E., Project Manager
Kentucky-American Water
2300 Richmond Road
Lexington, KY 40502

---

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance as stated in paragraph 15 of the Instructions To Bidders. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within fifteen days after the date of OWNER's Notice of Award.

3. In submitting this Bid, Bidder represents, as more fully set forth in the Agreement:

(a) Bidder has examined copies of all the Bidding Documents and of the following Addenda (receipt of all which is hereby acknowledged):

Date	Number
_____	_____
_____	_____
_____	_____

(b) Bidder has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

(c) Bidder has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 4.2 of the General Conditions, and accepts the determination set forth in Paragraph GC-4.2.2 of the General Conditions, as may be ammended by the Supplemental Conditions, of the extent the technical data contained in such reports and drawings upon which Bidder is entitled to rely.

(d) Bidder has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests and studies (in addition to or to supplement those referred to in (c) above) which pertain to the subsurface or physical conditions at the site or otherwise which may affect the cost, progress, performance

or furnishing of the Work as Bidder considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by Bidder for such purposes.

(e) Bidder has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by Bidder in order to perform and furnish the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.3 of the General Conditions.

(f) Bidder has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

(g) Bidder has given ENGINEER written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to Bidder.

(h) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

4. Bidder will complete the Work for the price(s) shown.

Where materials are furnished by the OWNER, the prices provided herein are for installation only. Otherwise the prices include furnishing and installation of materials.

LUMP SUM CONTRACT PRICE _____
($_____).

All specific cash allowances are included in the price(s) set forth above.

Contained in the lump sum bid is the sum of _____ dollars, ($_____) associated with cost of demolition of existing facilities and/or removal of existing material and/or equipment as required to complete the Work in accordance with the Contract Documents. This is the net cost to Bidder for such work taking into consideration estimated disposal costs or salvage values accruing to Bidder. This information is necessary for OWNER's financial accounting of project costs and will not be used in the selection of the successful Bidder.

Supplemental Unit Prices

When additional work is authorized, or work is deleted, by the OWNER, the following prices, when applicable, shall be used to determine the contract price adjustment. The items of Work and method of measurement to determine quantities shall be as described in Specifications.

SUPPLEMENTAL UNIT PRICES

5. Bidder will provide alternative equipment and/or materials (if any) as listed below in lieu of the specified equipment and/or materials in accordance with the General Requirements.

OWNER may select items of any manufacturer or supplier listed in the following tabulation. Bidder will furnish and install such items selected for a Contract Price equal to the lump sum Contract Price, adjusted by the amount of deduction for the substituted item(s).

In the following tabulation, the name of the manufacturer or supplier entered on line (a) is the name of the manufacturer or supplier named in the Specifications for that item and the cost for providing that specified item is included in the lump sum Contract Price. If the name of the manufacturer or supplier is not shown on line (a), it is understood that the lump sum Contract Price includes the cost for providing the item furnished by the manufacturer or supplier first named in that portion of the Specification pertaining to the equipment and/or materials being substituted.

Names of alternative manufacturers and suppliers are shown on lines (b) and (c) with the respective prices to be deducted from the lump sum Contract Price should the OWNER elect to accept the alternative item.

ALTERNATIVE EQUIPMENT AND/OR MATERIALS

Spec. Section	Item and Manufacturer of Supplier	Deduct from Base Bid
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____
_____	(a) _____	
	(b) _____	_____
	(c) _____	_____

6. Bidder agrees that the Work will be substantially complete within _____ calendar days after the date when the Contract Times commences to run as provided in Paragraph 2.3 of the General Conditions, and completed and ready for final payment within ____ calendar days after the date when the Contract Times commences to run.

Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work on time.

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

(a) Required Bid Security in the form of Bid Bond.

(b) Evidence of Bidder's qualification to do business in the State where the project is located.

(c) Bidder's contractor's license number if required to work in the State where the project is to be constructed.

(d) Information describing the proposed alternative equipment and/or materials.

8. The terms used in this Bid which are defined in the General Conditions of the Contract Documents have the meanings assigned to them in the General Conditions.

SUBMITTED on _____, 20____.

If Bidder is:

An Individual

By _____(SEAL)

(Individual's Name)

doing business as _____

Business address: _____

Phone No.: _____

A Partnership

By _____ (SEAL)

(Firm Name)

_____

(general partner)

Business address: _____

Phone No.: _____

A Corporation

By_____

(Corporation name)

_____

(state of incorporation)

By_____

(name of person authorized to sign)

_____

(Title)

(Corporate Seal)

Attest _____

(Secretary)

Business address: _____

Phone No.: _____

A Joint Venture

By_____

(Name)

_____

(Address)

By_____

(Name)

_____

(Address)

(Each joint venture 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).

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we

_____, as Principal and _____
(BIDDER)
_____ of the City of _____, State

of _____, a corporation existing under the laws and the State of _____

_____, and authorized to transact business in _____

_____, as Surety, are held and firmly bound unto

Kentucky-American Water

2300 Richmond Road, Lexington, KY 40502

hereinafter called the Obligee, in the sum of _____

_____Dollars ($_____),
lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying Bid dated _____, 20___, for the Franklin County 30 mgd Booster Pump Station and 3 mg Storage Tank Project.

NOW, THEREFORE, the condition of this Bond shall be such that if the Principal, upon due acceptance of said Bid and award of a Contract to him by the Obligee, bonds with good and sufficient surety as may be required by the Contract Documents, and furnishes the Obligee proper evidence of effectiveness of insurance coverage, respectively, within the time, in the forms and in the amounts, as appropriate, required by the Contract Documents, and enters into a Contract with the Obligee in accordance with the Contract Documents, then this Bond shall be void; otherwise, the Bond shall be and shall remain in full force and effect.

The Principal and the Surety hereby stipulate and agree that if the Principal fails to perform all conditions of this Bond, they will pay the sum of the Bond to the Obligee as fixed, liquidated damages.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of time within which the Obligee may accept such Bid; and said Surety does hereby waive notice of any such extension. It is the intention of the parties to be legally bound by this instrument.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals this _____ day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned and representative, pursuant to authority of its governing.

ATTEST:

DATE _____, 20___

WITNESS:

_____
Name of Bidder, Corporation
Firm or Individual

_____

By _____

_____
(Title)

_____

_____
Business Address of Bidder

ATTEST:

_____
Secretary

_____

_____
Surety

_____
Attorney-In-Fact

NOTE: This agreement must be properly executed and must accompany the Bid Bond as proposal security.

AGREEMENT OF SURETY

KNOW ALL MEN BY THESE PRESENTS, that we _____, as Surety, a corporation existing under the laws of the State of _____, and authorized to transact business in the State of _____; hereby agree to execute, within the time limit specified in the Contract, the Bonds, in the forms and in the amounts required for the faithful performance and proper fulfillment of the Contract for Construction of the Franklin County 30 mgd Booster Pump Station and 3 mg Storage Tank Project.

_____,

on behalf
of_____,
(Bidder)

hereinafter called the Bidder, provided that the Notice of Award be delivered to the Bidder within the time period that Bids are subject to acceptance or within any extended period for which the Bidder agrees not to withdraw his bid; and the Surety further agrees that should the Surety, after notification of such award, omit or refuse to execute the required bonds, then the Surety shall pay to the Kentucky-American Water the amount of the Bid Bond.

_____ _____
Date Corporate Surety

(AFFIX
_____CORPORATE
SEAL)

Title

_____

_____
Business Address

AGREEMENT

THIS AGREEMENT is dated as of the _____ day of _____ in the year 20___ by and between Kentucky American Water (hereinafter called OWNER) and _____ (hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK

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

FRANKLIN COUNTY 20 MGD BOOSTER PUMP STATION AND 3 MG STORAGE TANK PROJECT

Article 2. ENGINEER

The ENGINEER for the Project is Strand Associates, Inc. who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIMES

3.1 The Work will be substantially completed within _____ days from the date when the Contract Times commences to run as provided in Paragraph 2.3 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.13 of the General Conditions within _____ days from the date when the Contract Times commences to run.

3.2 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in Paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in providing 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 one thousand dollars ($1,000) for each day that expires after the times specified in Paragraph 3.1 for Substantial Completion until the Work is substantially complete. After Substantial Completion if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the Contract Times or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER one thousand dollars ($1,000) for each day that expires after the times specified in Paragraph 3.1 for completion and readiness for final payment.

Article 4. CONTRACT PRICE

4.1 OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds as follows:

Article 5. PAYMENT PROCEDURES

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

5.1 Progress Payment. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER. At intervals of once a month, the CONTRACTOR shall submit an estimate of the value of the Work completed to the first day of such month, and the value of materials and equipment suitably stored at the work site to be incorporated into the finished project. Upon approval by the OWNER, payment will be made for the net sum of ninety (90%) percent of such value less aggregate of previous payments. The net sum will be paid to the CONTRACTOR within thirty (30) days following receipt of the approved estimate.

5.2 Final Payment. Upon final completion and acceptance of the Work in accordance with Paragraph 14.13 of the General Conditions, OWNER shall pay the remainder of the Contract Price and any retained funds, as recommended by ENGINEER as provided in said Paragraph 14.13.

Article 6. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

6.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Contract Times, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

6.2 CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 4.2 of the General Conditions, and accepts the limitations set forth in Article 4, Section 4.2 of the General Conditions.

6.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in Paragraph 6.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise which may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

6.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site

and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by CONTRACTOR in order to perform and furnish the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.3 of the General Conditions.

6.5 CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

6.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

Article 7. CONTRACT DOCUMENTS

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

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

7.2 Performance and Labor and Material Payment Bonds, identified as exhibits A and B and consisting of 5 pages.

7.3 Notice of Award. (Note: This document is not attached to this Agreement.)

7.4 General Conditions (Document Identification: 5/91 - AWWS Co. Standard Documents, pages GC-0 to GC-29, inclusive).

7.5 Supplementary Conditions (pages ____ to ____, inclusive).

7.6 Specifications bearing the title _____ _____, and consisting of _____ divisions and _____ pages, as listed in table of contents thereof.

7.7 Drawings, consisting of a cover sheet and sheets numbered ____ through ____, inclusive with each sheet bearing the following general title:

(Note: Drawings have been furnished by ENGINEER and are not attached to this Agreement.)

7.8 Addenda numbers ____ to ____, inclusive.

7.9 CONTRACTOR's Bid (pages ____ to ____, inclusive) marked exhibit _____.

7.10 Documentation submitted by CONTRACTOR prior to Notice of Award (pages ____ to ____, inclusive).

7.11 The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Paragraphs 3.5 and 3.6 of the General Conditions.

7.12 The documents listed in Paragraphs 7.2 et seq. above are attached to this Agreement (except as expressly noted otherwise above).

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be amended, modified or supplemented as provided in Paragraphs 3.5 and 3.6 of the General Conditions.

Article 8. MISCELLANEOUS

8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meaning indicated in the General Conditions.

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

8.3 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

Article 9. OTHER PROVISIONS

9.1 Government Regulations

The following clauses, where applicable, are incorporated in this Agreement by reference as is fully set out; the Equal Opportunity Clause prescribed in 41 CFR 60-1.40, the Affirmative Action Clause prescribed in 41 CFR 60-250.4, regarding veterans and veterans of the Vietnam Era, and the Affirmative Action Clause for Handicapped Workers prescribed in 41 CFR 60-741.4.

CONTRACTOR accepts this Agreement and will supply any information relating to federal or state laws, rules or regulations relating to the above.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in quadruplicate. Two counterparts have been delivered to OWNER, and one counterpart each has been delivered to CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on _____, 20___.

OWNER _____

_____

By _____

(Corporate Seal)

Attest _____

Address for giving notices

_____

_____

CONTRACTOR _____

_____

By _____

(Corporate Seal)

Attest_____

Address for giving notices

_____

_____

License No. _____

(If CONTRACTOR is a corporation, attach evidence authority to sign.)

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____, having an office at _____, as Principal, hereinafter

called CONTRACTOR, and _____, having an office at

_____, as Surety, hereinafter called Surety, are held and firmly bound unto Kentucky-American Water, having an office at 2300 Richmond Road, Lexington, KY 40502, as Obligee, hereinafter called OWNER, for the use and benefit of claimants as herein below:

defined in the amount of _____

_____ ($_____), for the payment whereof CONTRACTOR and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, CONTRACTOR has by written agreement dated _____, 20__, entered into a Contract with the OWNER for the construction of the project entitled Franklin County 20 mgd Booster Pump Station and 3 mg Storage Tank Project, in accordance with Drawings and Specifications prepared by Strand Associates, Inc., which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if CONTRACTOR shall promptly make payment of all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however to the following conditions:

1. A claimant is defined as one having a direct contract with the CONTRACTOR or with a Subcontractor of the CONTRACTOR for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water,gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named CONTRACTOR and Surety hereby jointly and severally agreed with the OWNER that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The OWNER shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant:

a) Unless claimant, other than one having a direct contract with the CONTRACTOR, shall have given written notice to any two of the following: the CONTRACTOR, the OWNER or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or

for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the CONTRACTOR, OWNER or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

b) After the expiration of one (1) year following the date on which CONTRACTOR ceased Work on said Contract or after the expiration of one (1) year following the Date of Substantial Completion of the Project, whichever is later, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, on any part thereof, is situated, and not elsewhere.

4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against such improvement, whether or not claim for the amount of such lien be presented under and against this bond.

Signed and sealed this _____ day of _____, 19___.

WITNESS:

_____
CONTRACTOR (SEAL)

By_____

_____
(Witness)

_____
(Title)

WITNESS:

_____
(Name of Surety) (SEAL)

By_____
(Attach Power of Attorney)

_____
(Witness)

_____
(Title)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____,

having an office at _____, as Principal, hereinafter

called CONTRACTOR, and _____,

having an office at _____, as Surety, hereinafter

called Surety, are held and firmly bound unto the Kentucky-American Water, having an office at 2300 Richmond Road, Lexington, KY 40502, as Obligee, hereinafter called OWNER, for the use and benefit of claimants as

herein below defined, in the amount of _____ ($_____), for the payment whereof CONTRACTOR and Surety bind themselves, their heirs, executors, administrations, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, CONTRACTOR has by written agreement dated _____, 20___, entered into a Contract with the OWNER for the construction of the project entitled Franklin County 30 mgd Booster Pump Station and 3 mg Storage Tank, in accordance with Drawings and Specifications prepared by Strand Associates, Inc., which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of this obligation is such that, if CONTRACTOR shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of Contract Times made by the OWNER.

Whenever CONTRACTOR shall be and declared by OWNER to be in default under the Contract, the Surety shall promptly remedy the default. If the OWNER terminates the Contract for such default, the following precautions shall govern the liability of the CONTRACTOR and the Surety hereunder.

In the event of such termination, the CONTRACTOR and the Surety shall remain fully liable to the OWNER for the CONTRACTOR'S failure to timely complete the Contract, any additional costs incurred by the OWNER in completing the Contract, and liquidated damages from the originally scheduled completion date to the date of the actual completion of the work by the OWNER.

In the event of such termination, the Surety company may elect to take over and complete performance of the Contract by giving written notice to the OWNER of such determination within seven (7) days of the OWNER'S mailing of notice of termination to the Surety and actually commencing completion with fourteen (14) days of the OWNER'S notice to the Surety. The Surety shall fully complete the work by the originally scheduled date of completion and the CONTRACTOR and the Surety shall remain liable to the OWNER for all damages sustained by the OWNER and for liquidated damages for delay.

Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the Contract falls due or before the expiration of two (2) years from the Date of Substantial Completion of the Project, whichever is later.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the OWNER named herein or the heirs, executors, administrators or successors of the OWNER.

Signed and sealed this _____ day of _____, 20___.

WITNESS:

CONTRACTOR (SEAL)

By

(Witness)

(Title)

WITNESS:

(Name of Surety) (SEAL)

By _____

_____

(Witness)

_____

(Title)

GENERAL CONDITIONS

The General Conditions contained in this part of the Contract Documents are based on the Standard General Conditions of the Construction Contract prepared by the Engineers Joint Contract Documents Committee with modifications to be consistent with American Water System Policies. Only the General Conditions contained herein are a part of the Contract Documents for the project.

TABLE OF CONTENTS OF GENERAL CONDITIONS

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Whenever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1 *Addenda* -- Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding requirements or the Contract Documents.

1.2 *Agreement* -- The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.3 *Application for Payment* -- The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.4 *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.

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

1.6 *Bonds* -- Performance and Payment bonds and other instruments of security.

1.7 *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.

1.8 *Contract Documents* -- The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER's written interpretations and clarifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1 and 4.2.2 are not Contract Documents.

1.9 *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 11.9.1 in the case of Unit Price Work).

1.10 *Contract Times* -- The number of days or the dates stated in the Agreement (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13.

1.11 *CONTRACTOR* -- The person, firm or corporation with whom OWNER has entered into the Agreement.

1.12 *Defective* -- An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or 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 14.8 or 14.10).

1.13 *Drawings* -- The drawings which show the scope, extent and character of the Work to be furnished and performed by the CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents. Shop Drawings are not Drawings as so defined.

1.14 *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. However, the contractor has no rights or remedies arising from execution of the Agreement prior to the Commencement of Contract Times.

1.15 *ENGINEER* -- The person, firm or corporation named as such in the Agreement.

1.16 *ENGINEER's Consultant* -- A person, firm or corporation having a contract with OWNER to furnish professional services for the benefit of OWNER and ENGINEER with respect to the Project and who is identified as such in the Supplementary Conditions. The term ENGINEER's Consultant shall be deemed also to include a person, firm or corporation having a contract with ENGINEER's Consultant to furnish professional services as an independent professional associate or consultant to ENGINEER's Consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

1.17 *Field Order* -- A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.

1.18 *General Requirements* -- Sections of Division 1 of the Specifications.

1.19 *Hazardous Waste* -- The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 9603) as amended from time to time.

1.20 *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 or courts having jurisdiction.

1.21 *Liens* -- Liens, charges, security interests or encumbrances upon real or personal property.

1.22 *Notice of Award* -- The written notice to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

1.23 *Notice to Proceed* -- A written notice to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

1.24 *OWNER* -- The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

1.25 *Partial Utilization* -- Use by OWNER of a finished part of the Work for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

1.26 *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 and kerosene and oil mixed with other non-Hazardous Wastes and crude oils.

1.27 *PCBs* -- Shall mean Polychlorinated Biphenyls.

1.28 *Project* -- The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

1.29 *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.

1.30 *Resident Project Representative* -- The authorized representative of ENGINEER who may be assigned to the site or any part thereof.

1.31 *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.

1.32 *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.

1.33 *Specifications* -- Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.34 *Specifications Special Conditions* -- The part of the Contract Documents if used, that amends or supplements the Specifications.

1.35 *Subcontractor* -- An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.36 *Substantial Completion* -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidence by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

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

1.38 *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.

1.39 *Underground Facilities* -- All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephones or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

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

1.41 *Work* --The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

1.42 *Work Change Directive* -- A written directive 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 physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed 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 as provided in paragraph 10.2.

1.43 *Written Amendment* -- A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

ARTICLE 2 - PRELIMINARY MATTERS

Delivery of Bonds:

2.1 When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2 OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Times; Notice to Proceed:

2.3 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 thirty days after the Effective Date of the Agreement. In no event will owner have any obligations or duties to CONTRACTOR under the Agreement until Contract Times commence to run.

Starting the Work:

2.4 CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

Before Starting Construction:

2.5 Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon 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; however, 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 should have known thereof.

2.6 Within ten days after the Effective Date of the Agreement (unless otherwise specified in Division 1 -General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1 a preliminary progress schedule indicating the times (number of days or dates) for starting and completing the various stages of the Work, including any principal events (milestones) specified in the Contract Documents;

2.6.2 a preliminary schedule of Shop Drawings and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;

2.6.3 a preliminary 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.

2.7 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 paragraphs 5.4, 5.6 and 5.7.

Preconstruction Conference:

2.8 Within twenty days after the Contract Times start to run, but before any Work at the site is started, a conference attended by 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 2.6, procedures for handling Shop Drawings and other submittals, processing Applications for Payments, and maintaining required records.

Finalizing Schedules:

2.9 Unless otherwise provided in the Supplementary Conditions, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to finalize the schedules submitted in accordance with paragraph 2.6. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and submit the finalized schedules. No progress payment shall be made to CONTRACTOR until the finalized schedules are submitted to and acceptable to the ENGINEER as provided below. The finalized progress schedule will be as indicated in the Specifications and will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified milestone completion Times and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing scheduling or progress of the Work nor relieve CONTRACTOR from full responsibility therefore. CONTRACTOR's finalized schedule of Shop Drawings and Sample submissions will be acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the submittals. The CONTRACTOR's finalized schedule of values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3 -- CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

3.1 The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2 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 Work, 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 furnished and performed whether or not specifically called for. When words or phrases which have a well-known technical or construction industry or trade meaning are used to describe Work, materials or equipment such words or phrases shall be interpreted in accordance with that meaning. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3 Reference to Standards and Specifications of Technical Societies; Reporting and Resolving Discrepancies:

3.3.1 Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest 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.

3.3.2 If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier referred to in paragraph 6.5, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraphs 3.5 or 3.6; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or should have known thereof.

3.3.3 Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, 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:

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

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

No provisions of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's Consultants, agents or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4 Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved", or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgement of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgement will be solely to evaluate, in general, the completed Work for compliance with the information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as indicated by and reflected in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents. Where "provide" is used in the Specifications or Drawings, it shall be understood to mean, "provide complete in place", that is, furnish and install.

Amending and Supplementing Contract Documents:

3.5 The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.5.1 a formal Written Amendment,

3.5.2 a Change Order (pursuant to paragraph 10.4), or

3.5.3 a Work Change Directive (pursuant to paragraph 10.1).

3.6 In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.6.1 a Field Order (pursuant to paragraph 9.5),

3.6.2 ENGINEER's approval of a Shop Drawing or sample (pursuant to paragraphs 6.26 and 6.27), or

3.6.3 ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

3.6.4 Any variations and deviation in the Work arising from any of the methods set forth in Paragraph 3.6 will not authorize any ammendment to the Contract Price or Contract Times. The sole method to amend the Contract Price or Contract Times is pursuant to Paragraph 3.5.

Reuse of Documents:

3.7 CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not 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 Consultant; and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies or extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

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

Availability of Lands:

4.1 OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct 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 lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2 Subsurface and Physical Conditions:

4.2.1 Reports and Drawings: Reference is made to the Supplementary Conditions for identification of:

4.2.1.1 Subsurface Conditions at the Site: Those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparation of the Contract Documents; and

4.2.1.2 Physical Conditions: Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by the ENGINEER in preparing the Contract Documents.

4.2.2 Limited Reliance by CONTRACTOR Authorized; Technical Data: CONTRACTOR may rely upon the accuracy of the technical data contained in such reports and drawings, but such reports and drawings are not Contract Documents. Except for such reliance on technical data, CONTRACTOR may not rely upon and shall make no claim against OWNER, ENGINEER or any of the

ENGINEER's Consultants with respect to:

4.2.2.1 the completeness of such reports and drawings for CONTRACTOR's purposes,

4.2.2.2 nontechnical data, interpretations, opinions and information contained in such reports or otherwise relating to subsurface conditions at the site, or

4.2.2.3 nontechnical data, interpretations, opinions and information shown or indicated in such drawings or otherwise relating to such structures.

4.2.3 Reports of Differing Subsurface or Physical Conditions: If any subsurface or latent physical condition at the site that is uncovered or revealed (i) differs materially from that shown or indicated in the Contract Documents, or (ii) is of an unusual nature, which differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents, or (iii) is of such a nature as to require a change in the Contract Documents, or (iv) is of such a nature as to establish that any technical data on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, then 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 permitted by paragraph 6.23), notify OWNER and ENGINEER in writing about such condition.

4.2.4 ENGINEER's Review: ENGINEER will promptly review the pertinent conditions, determine the necessity of OWNER's obtaining additional explorations or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5 Possible Contract Documents Change: If ENGINEER concludes that a change in the Contract Documents is required as a result of a condition described in paragraph 4.2.3, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6 Possible Price and Time Adjustments: If a condition described in paragraph 4.2.3 causes an increase or decrease in the Contract Price or Contract Times, an equitable adjustment in the Contract Price (subject to the provisions of paragraphs 9.10 and 11.9 with respect to Unit Price Work) or an equitable adjustment of the Contract Times, or any combination thereof, will be allowed, to the extent that such condition has caused an increase or decrease in CONTRACTOR's cost of, or time required for performance of the Work, whether or not the Contract Documents are changed pursuant to paragraph 4.2.5, provided that:

4.2.6.1 such subsurface or physical condition was unknown to and could not reasonably have been anticipated by CONTRACTOR, and

4.2.6.2 such subsurface or physical condition meets the criteria established in paragraph 4.2.3, and

4.2.6.3 CONTRACTOR has timely given the written notice required by paragraph 4.2.3, and

4.2.6.4 CONTRACTOR has complied with the requirements of Article 6 of the Agreement.

If OWNER and CONTRACTOR are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project or that otherwise do not increase CONTRACTOR's cost of the Work.

4.3 Physical Conditions -- Underground Facilities:

4.3.1 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 or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1 OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2 The cost of all of the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2 Not Shown or Indicated: If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated 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 6.23), identify the owner of such Underground Facility and give

written notice thereof 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 consequence of the existence of the Underground Facility. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated 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 the amount or length of any such adjustment in Contract Times or Contract Price, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project or that otherwise do not increase CONTRACTOR's cost of the Work.

Reference Points:

4.4 OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgement 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 shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point 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 by professionally qualified personnel.

4.5 Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:

4.5.1 OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material 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 and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought onto the job site by CONTRACTOR, Subcontractors, Suppliers or anyone else for whom CONTRACTOR is responsible.

4.5.2 CONTRACTOR shall immediately (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23) and (ii) notify OWNER and ENGINEER (and 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 hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special 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 the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefor as provided in Articles 11 and 12.

4.5.3 If after receipt of such special 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 such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree to entitlement to or the amount or extent of an adjustment, if any, 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 Articles 11 and 12. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

4.5.4 To the fullest extent permitted by Laws and Regulations OWNER shall indemnify and hold harmless CONTRACTOR and ENGINEER and their respective officers, directors, consultants, Subcontractors, agents and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising out of or resulting from such hazardous condition, provided that (a) any such claim, damage, loss or expense 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, and (b) nothing in this subparagraph 4.5.4 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

4.5.5 The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCB's, Petroleum, Hazardous

Waste or Radioactive Material uncovered or revealed at the site.

4.5.6 In accordance with the intent of the Federal Occupational Safety and Health Administration (OSHA) Standard Section 29CFR-1910.12, Hazard Communication with effective date of May 25, 1986, as it may be amended from time to time, the OWNER hereby notifies the CONTRACTOR Work is to be performed on company property where the CONTRACTOR's employees may be exposed to hazardous materials existing on the premises.

Chemicals known to be used or stored by the OWNER and required to be disclosed by said OSHA Standard Section 29CFR-1910.12 are listed in the Supplementary Conditions.

OWNER, CONTRACTOR and any Subcontractors will each provide or make available to the others: (a) any written hazard communication program required to be maintained with respect to the site and any material safety data sheet and other hazard communication information required to be provided in accordance with applicable Laws and applicable Regulations, or (b) in the event that applicable Laws and Regulations do not require the provision or exchange of such hazard communications, CONTRACTOR and any Subcontractors shall, nevertheless, provide or make available to OWNER and any other employers at the site a written hazard communication program, material safety data sheets and other hazard communication information of the type and consistent with the intent of said OSHA Standard Section 29CFR-1910.12 and acceptable to OWNER and ENGINEER. CONTRACTOR shall be responsible for coordinating any such required exchange of documents or information between or among OWNER, and any other employers at the site, or any of them. CONTRACTOR shall include the provisions of this paragraph 4.5.6 in any subcontract for any part of the Work at the site.

ARTICLE 5 -- BONDS AND INSURANCE

Performance and Other Bonds:

5.1 CONTRACTOR shall furnish a Performance Bond, and a Labor and Material Payment Bond, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by the Contract Documents, except as otherwise provided by Laws or Regulations, and be executed by such sureties having a rating of "A" by the most recent Best's Key Rating Guide, and 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 Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2 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 paragraphs 5.1, CONTRACTOR shall within ten days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

5.3 Licensed Sureties and Insurers; Certificates of Insurance:

5.3.1 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.

5.3.2 CONTRACTOR shall deliver to OWNER, with copies to each additional insured indicated in the Supplementary Conditions, including ENGINEER, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.4. OWNER shall deliver to CONTRACTOR certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7 hereof.

CONTRACTOR's Liability Insurance:

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

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

5.4.2 claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

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

5.4.4 claims for damages insured by customary personal injury liability coverage which are sustained (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5.4.5 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

5.4.6 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.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7 with respect to insurance required by paragraphs 5.4.3 through 5.4.6 inclusive, include as additional insureds OWNER and ENGINEER (subject to any customary exclusion in respect of professional liability) and any other persons or entities indicated in the Supplementary Conditions, all of whom shall be listed by name as additional insureds, and include coverage for the respective officers and employees of all such additional insureds;

5.4.8 include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Law and Regulation, whichever is greater;

5.4.9 include completed operations insurance;

5.4.10 include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.16, 6.31 and 6.32;

5.4.11 contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least 30 days prior written notice has been given to OWNER, ENGINEER and each other additional insured indicated in the Supplementary Conditions to whom a certificate of insurance had been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.3.2 will so provide);

5.4.12 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 13.12; and

5.4.13 with respect to completed operations insurance and any other insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and any other additional insured indicated 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).

OWNER's Liability Insurance:

5.5 OWNER shall be responsible for purchasing and maintaining OWNER's own liability insurance and, at OWNER's option, may purchase and maintain such insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Builders Risk Property Insurance:

5.6 Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain "builders risk" property insurance upon the Work at the site in the amount of the full replacement cost there (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws or Regulations). This insurance shall:

5.6.1 include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultant, and any other persons or entities indicated in the Supplementary Conditions, all of whom shall be listed as insureds or additional insureds;

5.6.2 be written on a Builder's Risk "all-risk" policy form, shall at least include insurance for physical loss and damage, and shall insure against the peril of fire and extended coverage, theft, vandalism and malicious mischief, earthquake, temporary buildings, falsework, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations and water damage, and such other perils as may be provided in the Supplementary Conditions;

5.6.3 include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals);

5.6.4 cover materials and equipment stored on or off the site or in transit prior to being incorporated in the Work where such materials and equipment are included in an approved Application for Payment; and

5.6.5 be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER, with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7 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 OWNER, CONTRAC-

TOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other insureds as may be indicated in the Supplementary Conditions, all of whom shall be listed by name as insureds or additional insureds.

5.8 All the policies of insurance (or the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days prior written notice has been given to 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 5.11.

5.9 OWNER shall not be responsible for purchasing and maintaining any property insurance 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 the 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.

5.10 If CONTRACTOR requests in writing that other special insurance be included in the property insurance policy, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. 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.

Waiver of Rights:

5.11 OWNER and CONTRACTOR intend that all policies provided in response to paragraphs 5.6 and 5.7 will protect all of the parties listed as insureds or additional insureds in such policies and provide primary coverage for all losses and damages covered by perils insured 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 parties so listed. Accordingly, OWNER and CONTRACTOR waive all rights against each other for all losses and damages caused by any of the perils covered by such policies and any other property insurance applicable to the Work to the extent of insurance proceeds received under all such policies; and, in addition, waive all such rights against Subcontractors and all other parties so listed, and also against ENGINEER and ENGINEER's Consultants, for losses and damages so caused. None of the above waivers shall extend to the rights that any of the parties so listed may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

Receipt and Application of Proceeds:

5.12 Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 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 5.13. 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 monies so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13 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 fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection is 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.

Acceptance of Insurance:

5.14 If OWNER has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.1, 5.2, 5.3 and 5.4 and any applicable provisions of the Supplementary Conditions on the basis of their not complying with the Contract Documents, OWNER shall notify CONTRACTOR in writing thereof within ten days of the date of delivery of such certificates (or other evidence requested) in accordance with paragraph 2.7. If CONTRACTOR has any objection to the coverage afforded by or other provisions of the policies of insurance required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 and any applicable provisions of the Supplementary Conditions on the basis of their not complying with the Contract Documents, CONTRACTOR shall notify OWNER in writing thereof within ten days of the date of delivery of such certificates (or other evidence requested) in accordance with paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided by each as the other may reasonably request.

Partial Utilization -- Property Insurance:

5.15 If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected the 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 cancelled or permitted to lapse on account

of any such partial use or occupancy.

ARTICLE 6 -- CONTRACTOR's RESPONSIBILITIES

Supervision and Superintendence:

6.1 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, but CONTRACTOR shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2 CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The OWNER shall have the right to reject or demand replacement of such superintendent at any time, with or without cause, solely at the OWNER's discretion, based upon objective or subjective reasons, which reasons the OWNER may, but is not required to, disclose to the CONTRACTOR. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3 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. 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 indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4 Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all 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 furnishing, performance, testing, start-up and completion of the Work.

6.5 All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for 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 kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier, except as otherwise provided in Contract Documents.

Progress Schedule:

6.6 CONTRACTOR shall adhere to the finalized progress schedule established in accordance with paragraph 2.9, as it may be adjusted from time to time in accordance with the Contract Documents. CONTRACTOR shall submit to the ENGINEER for acceptance (to the extent indicated in paragraph 2.9) adjustments in the finalized progress schedule to reflect the impact thereon of new developments. Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

Substitutes and "Or-Equal" Items:

6.7 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, no like, equivalent, or "or equal" item or substitution is permitted.

6.8 Concerning Subcontractors, Suppliers and Others:

6.8.1 CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2) whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER'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 person or organization so identified may be revoked on the basis of

reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute. The Contract Price or Contract Times will be adjusted by the difference in the cost or time occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work.

6.9 CONTRACTOR Responsible for Subcontractors:

6.9.1 CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers, and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR, just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Contractor, Supplier, or other person or organization except as may otherwise be required by Laws or Regulations.

6.9.2 CONTRACTOR shall be fully responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require any Subcontractor, Suppliers or other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

6.10 The divisions and sections of the Specifications and the identification 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.

6.11 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 5.6 or 5.7, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by any of the perils 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.

Patent Fees and Royalties:

6.12 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. CONTRACTOR shall idemnify and hold harmless and defend OWNER and ENGINEER and ENGINEER's Consultants and anyone directly or indirectly employed by any of them from and against all claims, damages, losses and expenses (including but not limited to fees of engineers, architects, attorneys, and other professionals, and court and arbitration costs) arising out of 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.

Permits:

6.13 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. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

6.14 Laws and Regulations:

6.14.1 CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and 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.

6.14.2 If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all costs arising therefrom; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and

Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.3.2.

Taxes:

6.15 Unless otherwise provided in the Supplementary Conditions, 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.

Use of Premises:

6.16 CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises 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. Should any claim be made against OWNER or ENGINEER by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, idemnify, hold harmless and defend OWNER, ENGINEER and ENGINEER's Consultants and anyone directly or indirectly employed by any of them from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against OWNER, ENGINEER or ENGINEER's Consultant to the extent caused by or based upon CONTRACTOR's performance of the Work.

6.17 During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18 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.

Record Documents:

6.19 CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all 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.

Safety and Protection:

6.20 CONTRACTOR shall be 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:

6.20.1 all persons on the Work who may be affected by the Work;

6.20.2 all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

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

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them 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 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. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant 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 person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and the protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRAC-

TOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.21 Safety Representative: CONTRACTOR shall designate an 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.

6.22 In performing the Work, CONTRACTOR shall take all measures to prevent the release, spillage or improper disposal of any hazardous substance or construction or waste materials which may contaminate the OWNER's or adjacent properties or the environment or substantially endanger human health. The transportation, handling, storage and use of gasoline, oils, paints, residual cleaning solvents and other hazardous substances or contaminating materials by CONTRACTOR or any Subcontractor shall be in such a manner to prevent release, spillage or improper disposal. Should any such hazardous substances or contaminating materials be released, spilled or improperly disposed of by the CONTRACTOR or any Subcontractors, the CONTRACTOR shall immediately notify the OWNER and ENGINEER, notify any applicable environmental agency as required by Laws and Regulations, and immediately remedy or remove such substances or materials, and clean and restore the affected areas to a safe condition and to the satisfaction of the OWNER and any applicable environmental agency. The CONTRACTOR shall pay all costs for the remedy or removal of contaminate materials and the proper disposal of them at an approved and permitted site and the restoration of the affected areas. The CONTRACTOR shall also be responsible for the payments of and shall indemnify, hold harmless and defend the OWNER, ENGINEER and ENGINEER's Consultant from all penalties, fines and damage claims resulting from the release, spillage or improper disposal by CONTRACTOR or any Subcontractor of any such hazardous substances or contaminating material.

Emergencies:

6.23 In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER or OWNER, 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. 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 to document the consequences of the changes or variations.

Shop Drawings and Samples:

6.24 CONTRACTOR shall submit:

6.24.1 Shop Drawings to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9). All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The 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 materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.26.

6.24.2 Samples to ENGINEER for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

6.25 *Verification and Notice of Variations:*

6.25.1 Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified (i) all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto, (ii) all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and (iii) all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto. CONTRACTOR 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.

6.25.2 Each submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

6.25.3 At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

6.26 ENGINEER will review and approve Shop Drawings and Samples in accordance with the final schedule of Shop Drawings and Sample submittals accepted by ENGINEER as

required by paragraph 2.9. 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. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a specific 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. 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.

6.27 ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.3 and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.25.1.

6.28 Where a Shop Drawing or Sample is required by the Contract Documents or the final schedule of Shop Drawings and Sample submissions accepted by ENGINEER as required by paragraph 2.9, 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.

Continuing the Work:

6.29 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 15.5 or as CONTRACTOR and OWNER may otherwise agree in writing.

6.30 CONTRACTOR's General Warranty and Guarantee

6.30.1 CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be *defective*.

6.30.2 CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute and unconditional. 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:

6.30.2.1 observations by ENGINEER;

6.30.2.2 recommendation of any progress or final payment by ENGINEER;

6.30.2.3 the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

6.30.2.4 any use or occupancy of the Work or any part thereof by OWNER;

6.30.2.5 any act or acceptance by OWNER or any failure to do so;

6.30.2.6 any review and approval of a Shop Drawing or Sample submittal, or the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13; or

6.30.2.7 any inspection, test or approval by others; or

6.30.2.8 any correction of *defective* Work by OWNER.

6.31 *Indemnification:*

6.31.1 To the fullest extent permitted by Laws and Regulations CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant and the affiliated companies, consultants, agents, officers, directors and employees of each and any of them from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, personal 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 and (b) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.31.2 In any and all claims against OWNER, ENGINEER, ENGINEER's Consultant or the affiliated companies, consultants, agents, officers, directors, or employees of each or any of them by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, any

person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 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 person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.31.3 If any provisions of paragraphs 6.31 or 6.32 in respect of indemnification is prohibited or unenforceable by applicable law, then said paragraphs 6.31 and 6.32, as applicable, shall be reformed and amended so that the parties indemnified hereunder are provided with the fullest extent of indemnification as is permitted under applicable law and the remainder of the Contract Documents shall remain in full force and effect and not be invalidated.

6.32 *Survival of Obligations:*

All representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

ARTICLE 7 -- OTHER WORK

Related Work at Site:

7.1 OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefor which shall contain General Conditions similar to these, or have other Work performed by utility owners. If the fact that such other Work is to be performed was not noted in the Contract Documents, then (i) written notice thereof will be given to CONTRACTOR prior to starting any such other Work and (ii) CONTRACTOR may make a claim therefor as provided in Articles 11 and 12 if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2 CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the additional Work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and 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.

7.3 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 work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure so to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in such other work.

Coordination:

7.4 If OWNER contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1 the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

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

7.4.3 the extent of such authority and responsibilities will be provided. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8 -- OWNER's RESPONSIBILITIES

8.1 Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2 In case of termination of the employment of ENGINEER's Consultant, OWNER may appoint a replacement whose status under the Contract Documents shall be that of the former ENGINEER's Consultant.

8.3 OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.4 and 14.13.

8.4 OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and drawings of

physical conditions in or relating to existing structures which have been utilized by ENGINEER in preparing the Drawings and Specifications.

8.5 OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.

8.6 OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7 OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8 In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

8.9 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 furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.10 OWNER's responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site is set forth in paragraph 4.5.

ARTICLE 9 -- ENGINEER's STATUS

9.1 *OWNER's Representative:*

9.1.1 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 shall not be extended without written consent of OWNER and ENGINEER.

9.1.2 The assignment of any authority, duties or responsibilities to ENGINEER under the Contract Documents, or any undertaking, exercise or performance thereof by ENGINEER, is intended to be for the sole and exclusive benefit of OWNER and not for the benefit of CONTRACTOR, Subcontractor, Supplier or any other person or organization.

Visits to Site:

9.2 Subject to the limitations of authority and responsibilities indicated in paragraph 9.13, 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 will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections 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 on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against *defective* Work. ENGINEER will not supervise, direct or have control over any of CONTRACTOR's Work during such visits or as a result of such observations of CONTRACTOR's Work.

Project Representative:

9.3 If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. The duties, responsibilities and limitations of authority of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions. If OWNER designates another agent to represent OWNER at the site who is not ENGINEER's agent or employee, the duties, responsibilities and limitations of authority of such other person will be as provided in the Supplementary Conditions.

Clarifications and Interpretations:

9.4 ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If CONTRACTOR or OWNER believes that a written clarification or interpretation justifies an adjustment in the Contract Price or an adjustment, if any, of the Contract Times and the parties are unable to agree to the amount or extent thereof, CONTRACTOR or OWNER may make a claim therefor as provided in Article 11 or Article 12. All requests from CONTRACTOR for clarification or interpretation shall be submitted to ENGINEER in writing.

Authorized Variations in Work:

9.5 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 complete 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 CONTRACTOR or OWNER believes

that a Field Order justifies an adjustment in the Contract Price or an extension of the Contract Times and the parties are unable to agree as to the amount or extent thereof, CONTRACTOR or OWNER may make a claim therefor as provided in Article 11 or 12.

Rejecting Defective Work:

9.6 ENGINEER will have authority to disapprove or 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 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7 In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

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

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

Determinations for Unit Prices:

9.10 ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Appeal in accordance with paragraph 9.12 will not be subject to procedures of paragraph 9.11.

Decisions on Disputes:

9.11 Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute and other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after the start of such occurrence or event unless ENGINEER allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to ENGINEER and the claimant within thirty days after receipt of the claimant's last submittal (unless ENGINEER allows additional time). ENGINEER will render a formal decision in writing within a reasonable time after receipt of the opposing party's submittal, if any, in accordance with this paragraph.

9.12 ENGINEER's written decisions pursuant to paragraphs 9.10 and 9.11 will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other party to the Agreement and to ENGINEER written notice of intention to appeal ENGINEER's decision. Delivery of such written notice of intention to appeal a decision by ENGINEER pursuant to paragraphs 9.10 or 9.11 with respect to any claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.15) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant to Article 16. OWNER and CONTRACTOR agree to defer the exercise of their respective rights and remedies under Article 16 with respect to any claim, dispute or other matter that is the subject of such notice of intention to appeal until the making and acceptance of final payment, unless such deferral would irrevocably prejudice the rights of OWNER or CONTRACTOR. OWNER and CONTRACTOR intend to attempt to negotiate a settlement of any outstanding claims at or before the making and acceptance of final payment.

9.13 Limitations on ENGINEER's Authority and Responsibilities

9.13.1 Neither ENGINEER's responsibility or authority to act under this Article 9 or under any other provision of the Contract Documents or under any agreement between OWNER and ENGINEER or OWNER and ENGINEER's Consultant 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 owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety, or employee or agent for any of them.

9.13.2 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 furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3 ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any

Suppliers, or of any other person or organization performing or furnishing any of the Work.

9.13.4 ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. When functioning as initial interpreter and judge, ENGINEER will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

ARTICLE 10 -- CHANGES IN THE WORK

10.1 Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, 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).

10.2 If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefor as provided in Article 11 and Article 12.

10.3 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 and supplemented as provided in paragraphs 3.5 and 3.6, except in the case of an emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4 OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

10.4.1 changes in the Work which are (i) ordered by OWNER pursuant to paragraph 10.1, (ii) required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2 changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3 changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

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 6.29.

10.5 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, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11 -- CHANGE OF CONTRACT PRICE

11.1 The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2 The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such start of the occurrence or event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3 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:

11.3.1 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 paragraphs 11.9.1 through 11.9.3 inclusive);

11.3.2 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). Such allowance shall not exceed a fee calculated in accordance with paragraph 11.6.2.

11.3.3 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 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's fee for overhead and

profit (determined as provided in paragraph 11.6).

Cost of the Work:

11.4 The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. 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 11.5.

11.4.1 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 after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2 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 all returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3 Payments made by CONTRACTOR to the Subcontractors for Work performed or furnished 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 accepted. 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 paragraphs 11.4, 11.5, 11.6 and 11.7. All Subcontractors shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4 Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accounts) employed for services specifically related to the work, only to the extent authorized and approved in writing by the ENGINEER.

11.4.5 Supplemental costs including the following:

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

11.4.5.2 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.

11.4.5.3 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, installation, dismantling and removal thereof all 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.

11.4.5.4 Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5 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.

11.4.5.6 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 and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7 The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8 Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, express delivery and similar petty cash items in connection

with the Work.

11.4.5.9 Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5 The term Cost of the Work shall not include any of the following:

11.5.1 Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, project 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 a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4 all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

11.5.2 Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

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

11.5.4 Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5 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.

11.5.6 Other overhead or general expense costs of any kind.

11.5.7 The costs of any item not specifically and expressly included in paragraph 11.4.

CONTRACTOR's Fee:

11.6 The CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1 a mutually acceptable fixed fee; or

11.6.2 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:

11.6.2.1 for costs incurred under paragraphs 11.4.1 and 11.4.2 the CONTRACTOR's Fee shall be fifteen percent;

11.6.2.2 for costs incurred under paragraph 11.4.3 the CONTRACTOR's fee shall be five percent;

11.6.2.3 where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 11.4.1, 11.4.2, 11.4.3 and 11.6.2 is that the Subcontractor who actually performs or furnishes the Work, at whatever tier, will be paid a fee of fifteen percent of the costs incurred by such Subcontractor under paragraphs 11.4.1 and 11.4.2 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, for example:

Cost of the Work Performed by Sub-Subcontractor	= $10,000.00
Sub-Subcontractor's Fee (15 percent)	1,500.00
Total to Sub-Subcontractor	$11,500.00
Subcontractor's Fee (5 percent)	575.00
Subtotal	$12,075.00
CONTRACTOR's Fee (5 percent)	603.75
Total Change Order	= $12,678.75

11.6.2.4 no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.5 the amount of credit to be allowed by CONTRACTOR or OWNER for any such 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 ten percent of the net decrease; and

11.6.2.6 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 11.6.2.1 through 11.6.2.5 inclusive.

11.7 Whenever the cost of any Work is to be determined pursuant to paragraph 11.4 and 11.5, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8 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 done by such Subcontractors or Suppliers and for such sums within the limit of the allowances as may be acceptable to ENGINEER. CONTRACTOR agrees that:

11.8.1 The 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

11.8.2 CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit

and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances. No demand for additional payment on account of any of the foregoing will be valid.

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.

Unit Price Work:

11.9.1 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 established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. 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 in accordance with paragraph 9.10.

11.9.2 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.

11.9.3 CONTRACTOR or OWNER may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1 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

11.9.3.2 there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3 if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof or OWNER believes that OWNER is entitled to a decrease in Contract Price; and

11.9.3.4 the parties are unable to agree as to the amount of any such increase or decrease.

Delays Beyond the Control of Both Parties:

11.10 Neither OWNER nor CONTRACTOR shall be entitled to an increase or decrease in the Contract Price, nor to any other compensation or damages from the other as the result of delays beyond the control of both OWNER and CONTRACTOR, such as fires, floods, epidemics, abnormal weather conditions or acts of God.

ARTICLE 12 -- CHANGE OF CONTRACT TIMES

12.1 The Contract Times (or any applicable specified milestone completion date or time) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered to the other party and the ENGINEER within sixty days after the start of such occurrence (unless ENGINEER allows an additional period of time to submit additional or more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Times will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2 All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3 Where CONTRACTOR is prevented from completing the Work within the Contract Times (or any applicable specified milestone completion date or time), the Contract Times (or any applicable specified milestone completion date or time) will be extended in an amount equal to the time lost due to delays beyond the control of CONTRACTOR if a claim is made therefor as provided in paragraph 12.1. At OWNERs option, the Contract Times (or any applicable specified milestone completion date or time) will be extended for the entire Work or only that portion of the Work affected by the event giving rise to the claim. The CONTRACTOR will be notified in writing of the OWNERs decision in this matter. If OWNER elects to extend the Contract Times (or any applicable specified milestone completion date or time) for the affected portion of Work only, liquidated damages, if applicable, will be apportioned between affected Work and non-affected Work based on the value each portion represents as a percentage of the Contract Price. 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. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.4 Where CONTRACTOR is prevented from completing the Work within the Contract Times (or any applicable specified milestone completion date or time), an extension of the Contract Times (or any applicable milestone completion

date or time) in an amount equal to the time lost due to delays beyond the control of both OWNER and CONTRACTOR shall be CONTRACTOR's sole and exclusive remedy for such delays. At OWNERs option, the Contract Times (or any applicable specified milestone completion date or time) will be extended for the entire Work or only that portion of the Work affected by the event giving rise to the claim. The CONTRACTOR will be notified in writing of the OWNERs decision in this matter. If OWNER elects to extend the Contract Times (or any applicable specified milestone completion date or time) for the affected portion of Work only, liquidated damages, if applicable, will be apportioned between affected Work and non-affected Work based on the value each portion represents as a percentage of the Contract Price. In no event shall OWNER or CONTRACTOR be liable to the other for damages arising out of or resulting from (i) delays caused by or within the control of the other, or (ii) delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

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

13.1 Notice of Defects: Prompt notice of all *defective* Work of which OWNER and ENGINEER have actual knowledge will be given to CONTRACTOR. All *defective* Work may be rejected, corrected or accepted as provided in this Article 13.

Access to Work:

13.2 ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories and governmental agencies with jurisdictional interests will have access to 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 progress so that they may comply therewith as applicable.

Tests and Inspections:

13.3 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.

13.4 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:

13.4.1 for inspections, tests or approvals covered by paragraph 13.5 below;

13.4.2 that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3 as otherwise specifically provided in the Contract Documents.

13.5 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 inspection, tests or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection, or approval. CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for OWNER's or ENGINEER's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

13.6 If any Work (including 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. Such uncovering 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.

13.7 Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from CONTRACTOR's obligations to perform the Work in accordance with the Contract Documents.

Uncovering Work:

13.8 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.

13.9 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. If it is found that such Work is *defective*, CONTRACTOR shall bear all direct, indirect and consequential costs and damages of such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction, (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs), and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If, however, such 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 any applicable specified milestone completion date), or both, directly attributable to such un-

covering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Article 11 and 12.

Owner May Stop the Work:

13.10 If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or 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 or any other party.

Correction or Removal of Defective Work:

13.11 If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with Work that is not *defective*. CONTRACTOR shall bear all direct, indirect and consequential costs and damages of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) made necessary thereby.

13.12 *Correction Period:*

13.12.1 If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or 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*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions, (i) correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with Work that is not *defective*, and (ii) satisfactorily correct or remove and replace any damage to other Work resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs and damages of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) will be paid by CONTRACTOR.

13.12.2 In special circumstances where a particular item of equipment is placed in continuous service for the benefit of the OWNER 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 or by Written Amendment.

13.12.3 Where *defective* Work (and damage to other Work resulting therefrom) has been corrected, removed or replaced under this paragraph 13.12, 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.

Acceptance of Defective Work:

13.13 If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall bear all direct, indirect and consequential 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 to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs). 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, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14 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 13.11, 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 and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. To the extent necessary to complete corrective and 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 Consultant such access to the site as may be necessary to enable OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs and damages of OWNER in exercising such rights and remedies 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, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such direct, indirect and consequential costs and damages will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, court and arbitration or other dispute resolution costs and all cost of repair and replacement of Work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14 -- PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1 The schedule of values established as provided in paragraph 2.9 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.

Application for Progress Payment:

14.2 At least thirty days before the date established for each progress payment, 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 required 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 and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3 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.

Review of Applications for Progress Payment:

14.4 ENGINEER will, within fifteen 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. Fifteen days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5 ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the executed Work as an experienced and qualified engineer 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 (i) the Work has progressed to the point indicated, and (ii) 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 9.10 and to any other qualifications stated in the recommendation), and (iii) 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. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or (ii) there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or OWNER to withhold payment to CONTRACTOR.

14.6 ENGINEER's recommendation of any payment, including final payment shall not mean that ENGINEER is 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 furnishing or performance of Work, or for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents.

14.7 ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such representations to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1 the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2 the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3 OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4 of ENGINEER's actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

14.7.5 claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work,

14.7.6 Liens have been filed in connection with the Work,

14.7.7 there are other items entitling OWNER to a set-off against the amount recommended, or

14.7.8 OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.7.1 through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action.

Substantial Completion:

14.8 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. Within a reasonable time thereafter, 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. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and 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 tentative list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen 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 fourteen 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. 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, maintenance, heat, utilities, insurance and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER 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.

14.9 OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10 Use by OWNER at OWNER's option of any substantially completed part of the Work, which (i) has specifically been identified in the Contract Documents, or (ii) OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and useable 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, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1 OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. 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. 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 therefore. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 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.

14.10.2 No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11 Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will 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 remedy such deficiencies.

Final Application for Payment:

14.12 After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.9) and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments, except that the progress payment shall be clearly marked "Final Application for Payment." The final Application for payment shall be accompanied by (i) all documentation called for in the Contract Documents including but not limited to the evidence of insurance required by subparagraph 5.4.13, (ii) consent of the surety, if any, to final payment, and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work.

Final Payment and Acceptance:

14.13 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, all 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 fifteen days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. At the same time ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, ENGINEER will return the Application 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. Thirty days after presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance, and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14 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 and recommendation of ENGINEER, and without terminating the Agreement, 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 5.1, 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.

Waiver of Claims:

14.15 The making and acceptance of final payment will constitute:

14.15.1 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 14.11 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by OWNER of any rights in respect of CONTRACTOR's continuing obligations under the Contract Documents; and

14.15.2 a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

OWNER May Suspend Work:

15.1 OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety 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 allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

OWNER May Terminate:

15.2 Upon the occurrence of any one or more of the following events:

15.2.1 if CONTRACTOR persistently fails 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 2.9 as revised from time to time);

15.2.2 if CONTRACTOR disregards or violates Laws or Regulations of any public body having jurisdiction or insurance requirements;

15.2.3 if CONTRACTOR disregards the authority of ENGINEER;

15.2.4 if CONTRACTOR violates in any substantial way any provisions of the Contract Documents;

15.2.5 if CONTRACTOR has numerous or serious violations of Laws and Regulations pertaining to worker protection or safety;

15.2.6 if CONTRACTOR makes the assignment for the benefit of creditors of any of the monies due CONTRACTOR under this Agreement;

15.2.7 if CONTRACTOR intentionally submits documentation that is false or misleading;

OWNER may, after giving CONTRACTOR (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, 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), 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 finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) such excess will be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such costs incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and when so approved by ENGINEER incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3 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.

15.4 Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

15.4.1 for 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;

15.4.2 for 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;

15.4.3 for amounts paid in settlement of terminated contracts with Subcontractors, Suppliers, and others (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs incurred in connection with termination of contracts with Subcontractors and Suppliers); and

15.4.4 for reasonable expenses directly attributable to termination.

CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss or any consequential damages arising out of such termination.

CONTRACTOR May Stop Work or Terminate:

15.5 If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted, or OWNER fails for thirty 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 Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement, and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within thirty days after it is submitted, or OWNER has failed for thirty days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may upon seven days' written notice to OWNER and ENGINEER stop the Work until payment of all amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude CONTRACTOR from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this paragraph.

ARTICLE 16 -- DISPUTE RESOLUTION

Subject to the provisions of paragraph 9.10, 9.11, and 9.12, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 -- MISCELLANEOUS

Giving Notice:

17.1 Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if 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 if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Time:

17.2.1 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.

17.2.2 A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

Notice of Claim:

17.3 Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other Party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

Cumulative Remedies:

17.4 The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraph 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3, and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, 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, and 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.

SUPPLEMENTARY CONDITIONS

The Supplementary Conditions amend or supplement the General Conditions (5/91 AWWS Co. Standard Documents Edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

Table of Contents

SUPPLEMENTARY CONDITIONS

SC-1 Definitions

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

Whenever the term "Water Company" is used in these Contract Documents it shall have the same meaning as OWNER or ENGINEER, whichever is applicable.

SC-1.16 ENGINEER'S Consultant

The ENGINEER'S Consultant**(s)** for this project **(is) (are)**:

* QORE, Inc. (name), 422 Codell Drive, Lexington, KY 40509 (address)

SC-2.10 Stipulation Waiver of Right to File Lien

Add a new paragraph immediately after Paragraph 2.9 of the General Conditions which is to read as follows:

> Simultaneous with the signing of the Agreement for a project to be constructed in Kentucky, and as a condition precedent to the enforceability of any provision of the Agreement by the CONTRACTOR, the CONTRACTOR shall execute and deliver to the OWNER the Stipulation Waiver of Right to File Lien in the form attached hereto. OWNER will file the executed Stipulation Waiver of Right to File Lien with the Prothonotary's office in the County where the project is located prior to the commencement of the Work or within ten days after the effective date of the Agreement.
>
> CONTRACTOR shall give a copy of the executed Stipulation Waiver of Right to File Lien to all Subcontractors, Suppliers, or any other person furnishing services, labor, materials or equipment to or for the Project under any contract with the CONTRACTOR at the time the orders are placed by the CONTRACTOR and prior to the time such services, labor, materials and equipment are furnished.

A copy of the form for filing the Stipulation Waiver of Right to File Lien is included in Appendix D attached to the Supplementary Conditions.

SC-4.2 Subsurface and Physical Conditions

4.2.1 In the preparation of Drawings and Specifications, ENGINEER has relied upon:

4.2.1.1 The following reports of explorations and tests of subsurface conditions at the site of the Work:

Report dated January 12, 2007 and amended report dated January 30, 2007 prepared by Qore, Inc., entitled Franklin County Pump Station and Tank, consisting of 45 pages and a one-page amendment.

Copies of these reports and drawings that are not included with the Bidding Documents may be examined at Kentucky-American Water and Strand Associates, Inc. office during regular business hours. These reports and drawings are not part of the Contract Documents.

SC-5.4 CONTRACTOR's Liability Insurance

The limits of liability for the insurance required by Paragraph 5.3 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

Workmen's Compensation Insurance: The CONTRACTOR shall carry Workmen's Compensation Insurance during the life of the Contract to insure his statutory liability to his employees in the state or states in which the work under this Contract is to be performed, plus $100,000 Employer's Liability Coverage.

General Liability: The CONTRACTOR shall carry Commercial General Liability Insurance during the life of the Contract. The policy shall be written on an occurrence basis and shall include broad form property damage coverage. The required limits for this coverage are to meet the limits shown in either of the sample Certificates of Insurance included in Appendix A of these Supplementary Conditions.
Automobile Liability: The CONTRACTOR shall carry the Comprehensive form of Automobile Liability and Property Damage Insurance during the life of the Contract. The required limits for this coverage are to meet the limits shown in either of the sample Certificates of Insurance included as Appendix A to these Supplementary Conditions.

Umbrella and/or Excess Liability: Depending on the limits provided in the above primary insurance policies the CONTRACTOR shall carry Umbrella and/or Excess Liability Insurance during the life of the Contract with limits meeting those shown in either of the sample Certificates of Insurance included as Appendix A to these Supplementary Conditions.

SC-5.4.7 Additional Insureds

The policies of insurance so required by Paragraph 5.4 shall include as additional insureds the following parties:

1. OWNER
2. ENGINEER
3. ENGINEER's Consultant

Regardless whether or not an Owners' and Contractors' Protective (OCP) policy or Project Management Protective Liability (PMPL) policy is furnished, insurance certificates for commercial general, automobile, umbrella, and builders risk shall specifically indicate by name the additional insureds which are to include OWNER and ENGINEER as well as other persons or entities so identified. Certificates shall be Acord 25-S or equivalent.

E. Additional Insured Endorsements/OCP policy/PMPL policy

1. CONTRACTOR shall purchase and maintain liability insurance, as described above, specifically naming as additional insureds OWNER and ENGINEER as well as other individuals or entities so identified (see the Supplementary Conditions), and specifically stating the following language as the Additional Insurance Endorsement on Form CG 20 26 07 04 or equivalent form:

> "That the persons insured under this policy is amended to include as an additional insured, OWNER and ENGINEER as well as other individuals and entities so identified, but only with respect to liability arising out of (1) operations performed for the additional insured by the named insured or (2) acts or failure to act by the additional insured in connection with general supervision, inspection and/or coordination of CONTRACTOR's operations.,"

2. As an alternative to providing Form CG 20 26 07 04, CONTRACTOR may furnish to OWNER an OCP policy or a PMPL policy, with ENGINEER as additional insured. OCP policy or PMPL policy shall provide for bodily injury and property damage coverage equal to the sum of: the general aggregate limit for commercial general liability plus the amount specified for the umbrella coverage. OCP policy or PMPL policy shall provide coverage arising out of:

i. operations performed by CONTRACTOR at the project location.

ii. acts or omissions in connection with the general supervision, inspection and/or coordination of such operations.

If an OCP or PMPL policy is provided, CONTRACTOR shall provide originals of the Final OCP or PMPL to all insured and additional insured parties.

Endorsements, OCP, and/or PMPL policy shall not exclude supervisory or inspection services.

F. Policies of insurance shall also include QORE, Inc. as additional insureds under the provisions of Paragraph 5.4 of the General Conditions.

SC-5.6 Builders Risk Insurance

The CONTRACTOR shall bear all risks of all loss or damage to the materials and Work until the Work is finally accepted by the OWNER, except that the CONTRACTOR may claim reimbursement under the OWNER's builder's risk insurance policy as herein provided and limited. OWNER will carry "All Risk" Builders Risk Insurance subject to deductibles, terms and conditions as stated in the policy and below. It is the obligation and responsibility of the

CONTRACTOR to make appropriate claim to the insurance company for all losses claimed under the policy. Should any loss not be covered under this policy, in whole in or parts, the CONTRACTOR shall bear the loss. Any questions regarding coverages, limitation, exclusion, etc. contained in the policy shall be addressed by bidders prior to submittal of bids, by Michaela Grasshoff, phone 212-488-0272, mgrasshoff@frenkel.com, or Ed Todd, 212-488-0456, etodd@frenkel.com, at Frenkel & Co. Inc., 1740 Broadway, New York, NY 10019, fax 212-488-0220.

Such insurance shall cover the full value of the cost of replacement to the OWNER, less applicable deductibles, of all completed portions of the work to be performed throughout the entire time of construction. The deductibles on each separate and unrelated loss are (1) 5% of the value of loss caused by earthquake and (2) $1,000 on all other losses. OWNER will furnish to the CONTRACTOR evidence of the insurance coverage provided.

Such insurance shall not cover (1) damage to or loss of material or equipment furnished by either party which are damaged or lost due to carelessness or negligence on the part of the CONTRACTOR, or (2) damage to or loss of machinery, tools, equipment, or other property furnished by the CONTRACTOR whether or not used by the CONTRACTOR in carrying out the terms of the Contract unless such machinery, tools, equipment or other property are specifically intended for permanent incorporation into the Contract work and are included in an approved application for payment.

SC-6.13 Permits

OWNER will obtain and pay for all necessary permits which by Laws or Regulations must be obtained by the OWNER. The CONTRACTOR will obtain and pay for all other permits, licenses and certificates of inspection. The CONTRACTOR will pay for all inspection costs and fees.

The CONTRACTOR and/or his Subcontractor(s) shall obtain, complete, seal and sign all applications required to obtain construction permits required by state and local government agencies. A Xerox copy of the electrician's and plumber's current state and/or local license shall be delivered to the OWNER.

When required by the local governing body, the electrician and plumber will execute a mechanical bond in the form approved by the local government.
All bonds, application forms and copies of licenses shall be delivered to the OWNER so these documents may be submitted with the OWNER's application for a building permit.

SC-6.15 Sales Tax

Add the following language after Paragraph 6.15 of the General Conditions:

> Without altering CONTRACTOR's full responsibility to properly determine and pay such taxes, the OWNER will provide the CONTRACTOR, for use at CONTRACTOR's risk, a copy of any Guidelines developed by the OWNER with respect to sales and use tax

exemptions in the state in which the Project is located. A copy of the Guidelines for the state in which the Project is located is included in Appendix C attached to the Supplementary Conditions.

CONTRACTOR shall indemnify and hold harmless the OWNER for any sales and use tax which OWNER is required to pay by reason of CONTRACTOR's failure to seek and to implement any available Sales and Use Tax Exemption and CONTRACTOR's failure to obtain any necessary exemption certificate.

OWNER may set off against monies otherwise due CONTRACTOR hereunder the amount of any sales and use tax, or any other tax, which OWNER is required to pay by reason of CONTRACTOR's failure to comply with Paragraph 6.15 of the General Conditions.

CONTRACTOR shall furnish evidence satisfactory to OWNER that CONTRACTOR has paid all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR. OWNER reserves the right to audit the CONTRACTOR's statement prior to release of retainage and final payment.

SC-9.3 Project Representation

The duties, responsibilities and limitations of authority of the Resident Project Representative shall be as follows:

A. General

The Resident Project Representative (RPR) is ENGINEER's agent at the site, will act as directed by and under the supervision of ENGINEER.

B. Duties and Responsibilities of RPR

1. Conferences and Meetings: Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

2. Liaison: Serve as ENGINEER's liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent and assist in understanding the intent of the Contract Documents; and assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-site operations.

3. Shop Drawings and Samples: Advise ENGINEER and CONTRACTOR of the commencement of any Work requiring a Shop Drawing or sample if the submittal has not been approved by ENGINEER.

4. Review of Work, Rejection of Defective Work, Inspections and Tests:

a. Conduct on-site observations of the Work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.

b. Report to ENGINEER whenever RPR believes that any 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.

c. Verify that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that CONTRACTOR maintains adequate records thereof.

5. Interpretation of Contract Documents: Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issued by ENGINEER.

6. Modifications: Consider and evaluate CONTRACTOR's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to ENGINEER. Transmit to CONTRACTOR decisions as issued by ENGINEER.

7. Payment Requests: Review applications for payment with CONTRACTOR for compliance with the established procedure for their submission and forward with recommendations to ENGINEER, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and equipment delivered at the site but not incorporated in the Work.

8. Completion:

a. Before ENGINEER issues a Certificate of Substantial Completion, submit to CONTRACTOR a list of observed items requiring completion or correction.

b. Conduct final inspection in the company of ENGINEER, OWNER and CONTRACTOR and prepare a final list of items to be completed or corrected.

c. Observe that all items on final list have been completed or corrected and make recommendations to ENGINEER concerning acceptance.

C. Limitations of Authority

Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by ENGINEER.

2. Shall not exceed limitations of ENGINEER's authority as set forth in the Agreement or the Contract Documents.

3. Shall not undertake any of the responsibilities of CONTRACTOR, subcontractors or CONTRACTOR's superintendent.

4. Shall not issue directions relative to, or assume control over, any aspect of the means, methods or techniques of construction unless such directions or control are specifically required by the Contract Documents.

SC-14.12 Final Application for Payment

Add the following language at the end of Paragraph 14.12 of the General Conditions:

CONTRACTOR, Subcontractors and Suppliers shall execute and deliver to OWNER their release of liens on forms supplied by OWNER. Blank forms are included in Appendix B of these Supplementary Conditions.

APPENDIX A

Limits of Liability Insurance

SC-5.6 CONTRACTOR's Liability Insurance is hereby supplemented to include the following:

The limits of liability for insurance required by General Conditions paragraph 5.6 are as shown on the attached ACORD sample Certificate of Insurance except that no Professional Liability Insurance is required.

Insurance Requirements.

(A) At no expense to American Water (hereinafter referred to as Company), Contractors and subcontractors shall, at its expense, obtain and keep in force during the term of this Agreement, and any renewals or extensions hereof, the following minimum insurance limits and coverage during the term of the agreement/contract to cover his legal liability to third parties in accordance with the Conditions of Contract. The insurance coverage limits stated below are minimum coverage requirements, not limitations of liability, and shall not be construed in any way as Owner's acceptance of the responsibility of the Contractor:

1. **Commercial General Liability**: $1,000,000 per occurrence Combined Single Limits
   $1,000,000 General Aggregate
   $1,000,000 Products and Completed Operations Aggregate

   Occurrence form including Premises and Operations Coverage, Products and Completed Operations, Coverage for Independent Contractors, Personal Injury Coverage and Blanket Contractual Liability. Contractor's Protective Liability if the Contractor subcontracts to another all or any portion of the Work. Completed Operations shall be maintained for a period of ten (10) years following Final Completion. The renewal of each annual policy shall include a three year extension of Completed Operations coverage.

2. **Workers Compensation**:

   A. Applicable Federal or State Requirements: Statutory minimum
   B. Employer's Liability
      Each Accident –$1,000,000
      Policy Limit –$1,000,000
      Disease
      Each Employee–$1,000,000
      Disease
   C. Voluntary workers compensation insurance covering all employees not subject to the applicable workers compensation act or acts.

The Workers' Compensation policy shall also include U.S. Longshoremen and Harbor Workers' Compensation Act Coverage, if any work shall be done over or within 100 feet of any body of water, or otherwise at the sole discretion of Company. It shall also provide maritime (Jones Act) coverage if a boat or vessel of any type is to be used.

3. **Automobile Liability**

Including owned, hired, borrowed and non-ownership liability.

Bodily Injury and Property Damage Liability	$1,000,000 each occurrence Combined Single Limits

4. **Umbrella Liability** $9,000,000 each occurrence and annual aggregate in

excess of Employer's Liability, General Liability and Automobile Liability (no more restrictive than the underlying insurance).

The minimum liability limits required may be satisfied through the combination of the primary General Liability, Employer's Liability, and Automobile Liability limits with an Umbrella Liability policy, with coverage no more restrictive than the underlying insurance, providing excess limits at least equal to or greater than the combined primary limits.

All Commercial General Liability including completed operations-products liability coverage and Automobile liability insurance shall designate Owner and Company, its parent, affiliates and subsidiaries, its directors, officers and employees as Additional Insured. All such insurance should be primary and non-contributory, and is required to respond and pay prior to any other insurance or self-insurance available to Owner and Company. In addition to the liability limits available, such insurance will pay on behalf or indemnify Owner and Company for defense costs. Any other coverage available to the Owner and Company applies on a contingent and excess basis. Such insurance shall include appropriate clauses pursuant to which the insurance companies shall waive its rights of subrogation against Owner and Company.

Contractor and subcontractors shall furnish prior to the start of work, certificates or adequate proof of the foregoing insurance including, if specifically requested by Company, copies of the endorsements and insurance policies naming Owner and Company as an Additional Insured. Current certificates of insurance shall be provided prior to the commencement of work and be maintained until completion of the contract. Owner shall be notified in writing at least thirty (30) days prior to cancellation of or material change in a policy. Carriers providing coverage will be rated by A.M. Best with at least an A- rating and a financial size category of at least Class VII. Such cancellation or material alteration shall not relieve

Contractor of its continuing obligation to maintain insurance coverage in accordance with this contract.

(B) If Contractor shall fail to procure and maintain said insurance, Owner or Company, upon written notice, may, but shall not be required to, procure and maintain same, but at the expense of Contractor. In the alternative, Owner or Company may declare a default hereunder and, unless such default is timely cured, terminate the Lease. Unless and until the default is cured, neither Contractor nor its servants, employees or agents will be allowed to enter upon the Premises.

ACORD CERTIFICATE OF INSURANCE

ISSUE DATE:

PRODUCER

VENDOR'S INSURANCE BROKER AND ADDRESS

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

COMPANIES AFFORDING COVERAGE

COMPANY LETTER A. ABC INSURANCE COMPANY

COMPANY LETTER B. XXX INSURANCE COMPANY

COMPANY LETTER C. YYY INSURANCE COMPANY

COMPANY LETTER D.

COMPANY LETTER E

INSURED

VENDOR/CONTRACTOR/TRADE I.A, I.B.
Address

COVERAGES

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A.	AUTOMOBILE LIABILITY ☒ ANY AUTO ☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS ☒ HIRED AUTOS ☐ COMP DED $500 ☒ NON-OWNED AUTOS	AL5678	1/1/2006	1/1/2007	COMBINED SINGLE LIMIT BODILY INJURY (Per Person)) BODILY INJURY (Per Accident) PROPERTY DAMAGE	$ 1,000,000 $ $ $
B.	EXCESS LIABILITY ☒ UMBRELLA FORM ☐ OTHER THAN UMBRELLA FORM	XS 9876	1/1/2006	1/1/2007	EACH OCCURRENCE AGGREGATE	$9,000,000 $9,000,000
A	WORKER'S COMPENSATION AND EMPLOYERS LIABILITY	WC 5432	1/1/2006	1/1/2007	☒ STATUTORY LIMITS EACH ACCIDENT DISEASE-POLICY LIMIT DISEASE-EACH EMPLOYEE	$1,000,000 $1,000,000 $1,000,000
	OTHER				Personal Property: $250,000 Deductible:	

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

(Reference Project Location or Contract No.)
Certificate holder is included as Additional Insured, except for workers compensation, with respect to liability arising out of the named insured's operations as required by written contract. Any coverage afforded to the Additional Insured shall apply as primary and not excess to any other insurance or self insurance available to Additional Insured. Waiver of Subrogation shall apply to all insurance.

CERTIFICATE HOLDER	CANCELLATION
American Water 800 W. Hershey Park Drive Hershey, PA 17033	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT. AUTHORIZED REPRESENTATIVE

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	OTHER				Personal Property: $250,000 Deductible:	

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CERTIFICATE HOLDER	CANCELLATION
Kentucky American Water 2300 Richmond Road Lexington, KY 40502	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, AUTHORIZED REPRESENTATIVE

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	OTHER				Personal Property: $250,000 Deductible:	

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CERTIFICATE HOLDER	CANCELLATION
Strand Associates, Inc. 325 W. Main Street, Suite 710 Louisville, KY 40202	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT. AUTHORIZED REPRESENTATIVE

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	OTHER				Personal Property: $250,000 Deductible:	

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CERTIFICATE HOLDER	CANCELLATION
QORE, Inc. 422 Codell Drive Lexington, KY 40509	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT. AUTHORIZED REPRESENTATIVE

APPENDIX B

RELEASE OF LIENS

WHEREAS, we, the undersigned, have installed or furnished labor, materials and/or equipment for the installation of the Project entitled Franklin County 30 MGD Booster Pump Station and 3 MGD Storage Tank, installed pursuant to a written agreement dated _____, 20___, between the Kentucky-American Water, having an office at 2300 Richmond Road, Lexington, KY 40502, hereinafter called OWNER and _____, having an office at _____, hereinafter called CONTRACTOR, which said facilities are owned by the OWNER and described and located as follows:

CONTRACTOR shall construct 30 mgd Booster Pump Station and 3 mg Storage Tank and all appurtenances thereto.

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the OWNER, or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation;

NOW THESE PRESENTS WITNESS that we the undersigned, in consideration of the premises, and of the sum of One Dollar ($1.00) in hand paid by the said OWNER, at and before the sealing and delivery hereof, the receipt whereof we do hereby acknowledge, have remised, released and forever quitclaimed, and by these presents do remise, release and forever quitclaim, unto the said OWNER, its successors and assigns, any and all manner of liens, claims and demands whatsoever which we now have, or might or could have, on or against the said facilities, or the owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the OWNER, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have, or might or could have against the same if these presents had not been made.

IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Company Name _____ (SEAL)

By _____

Title _____

Dated _____, 20 ___

Sworn to and subscribed before me,
a Notary Public, this _____ day
of _____, 20___.

_____ (SEAL)
Notary Public

I, _____, duly authorized representative of _____, designated as CONTRACTOR, do hereby state that the parties whose names are signed to the attached releases, pages 1 through ____, are all of the parties who have furnished labor, materials or equipment in connection with the construction of the facilities mentioned above; excepting only such materials as may have been furnished by the OWNER.

Dated: _____, 20 ___.

Sworn to and subscribed before me,
a Notary Public, this _____ day
of _____, 20___.

_____ (SEAL)
Notary Public

APPENDIX C

SPECIFICATIONS

SECTION 01010

SUMMARY OF WORK

PART 1–GENERAL

1.01 DIVISION ONE

A. The requirements of Division 1 apply to all sections of the Contract(s).

1.02 PROJECT SCOPE

A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

1.03 CONTRACT DOCUMENTS–INTENT AND USE

A. Intent of Documents:
   1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
   2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
   3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications, not referenced in individual sections shall apply as required for proper performance of the Work.
   4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
   5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.

B. Use of Documents:
   1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
   2. CONTRACTOR shall use all of the Project Drawings and Specifications:
      a. For a complete understanding of the Project.
      b. To determine the type of construction and systems required.
      c. For coordination with other contractors.
      d. To determine what other work may be involved in various parts or phases.
      e. To anticipate and notify others when work by others will be required.
      f. And all other relevant matters related to the project.
   3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work, as may be shown or inferred by the entire set of Project Drawings and Specifications.

1.04 CONTRACTOR USE OF SITE

A. General:
   1. The "area of the site" referred to in these specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the project right-of-way or the easements obtained for the project shall be considered the "area of the site."
   2. Construction activities shall be confined within the "area of the site" limits.
   3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
   4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
   5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

B. Parking and Deliveries:
   1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
   2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
   3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER.

1.05 EXISTING SERVICES, STRUCTURES AND UNDERGROUND FACILITIES

A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security will not be permitted, unless specifically indicated otherwise. Provide temporary facilities to maintain services.

B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.

C. Work shall not commence until all labor, materials and equipment are available so Work can continue without interruption or delay.

D. Should uncharted or incorrectly charted piping or other utilities be encountered during installation, notify OWNER and consult with utility owner immediately for directions.

E. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation and repair any damaged utilities to satisfaction of utility owner.

F. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.

G. Any accidental interruption of services shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.

H. Prior to any excavation, demolition, or drilling on site, CONTRACTOR shall contact owners of the underground facilities in and near the construction area of the intent to excavate, demolish, or drill. As part of this notification requirement, CONTRACTOR shall contact the utility protection center "BUD" (262-5123 or 1-800-752-6007) two working days in advance

of any work. CONTRACTOR shall be aware that not all owners participate in "BUD." A call to this agency shall not absolve CONTRACTOR of the requirements for contacting owners of all underground facilities in and near the construction area. CONTRACTOR shall give reasonable advance notice to "BUD" and other owners for the notification which shall not be less than the minimum advance notification required.

I. CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of structures and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such structures and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.

J. CONTRACTOR shall keep an accurate and complete record of all such structures and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.

K. CONTRACTOR shall inspect all structures and Underground Facilities for condition and soundness. Unsound conditions shall be reported to the structure or facility owner immediately after exposing. CONTRACTOR shall not proceed with the work until the structure or facility owner has been notified. OWNER shall then be given time to inspect and correct, if required, the structure or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.

L. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing structure or Underground Facility encountered shall be paid for by CONTRACTOR.

M. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing structures and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

1.06 PROTECTION OF WORK AND IMPROVEMENTS

A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.

B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.

C. CONTRACTOR shall keep property, existing improvements and the Work, including structures, mains, fittings and accessories free from dirt and foreign matter at all times.

D. CONTRACTOR shall provide temporary plugging of openings, holes and pipe ends that are existing or that CONTRACTOR has installed.

E. Property, improvements and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.

F. If more than one contractor is responsible, the cost shall be shared. ENGINEER will determine responsibility for damages. All repair and replacement methods shall be approved by OWNER.

1.07 AVAILABILITY OF LANDS

A. Easements were obtained for this project. CONTRACTOR shall contain its operation to within the rights-of-way or lands upon which the work is to be performed.

PART 2--PRODUCTS

NOT APPLICABLE

PART 3--EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01019

CONTRACT CONSIDERATIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Inspection and Testing Allowances.
   2. Measurement and Payment–Lump Sum.

1.02 INSPECTION AND TESTING ALLOWANCES

A. Costs Included in Inspection and Testing Allowances: Cost of engaging an inspection or testing firm; execution of inspection and tests; and reporting results.

B. Costs Not To Be Included in the Inspection and Testing Allowance But To Be Included in the Contract Price.
   1. Costs of incidental labor and facilities required to assist inspection or testing firm.
   2. Costs of testing laboratory services used by CONTRACTOR separate from Contract Document requirements.
   3. Costs of retesting upon failure of previous tests.
   4. Costs of tests specified to be provided by CONTRACTOR.

C. Payment Procedures: Submit one copy of the inspection or testing firm's invoice with next application for payment.

D. Refer to technical sections of specifications for required testing and any associated allowances.

E. Difference in final cost and allowance will be adjusted by Change Order.

1.03 MEASUREMENT AND PAYMENT–LUMP SUM

A. No separate measurement for payment will be performed for Lump Sum Work.

B. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.

C. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.

D. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.

1.04 SUPPLEMENTAL UNIT PRICES

A. Supplemental unit prices shall be provided as indicated in the Bid Form.

B. Refer to sections of the specifications identified in the Bid Form for specific information on use of supplemental unit prices.

C. Where quantities are specified, the Bid shall include the amount equal to the specified quantity times the supplemental unit price.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01039

COORDINATION, FIELD ENGINEERING, AND MEETINGS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Coordination.
   2. Field engineering.
   3. Progress meetings.
   4. Preinstallation meetings.

1.02 COORDINATION

A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. See Section 01010–Summary of Work for specific construction sequence.

B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.

1.03 FIELD ENGINEERING

A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.

B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels, utilizing recognized engineering survey practices.

C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.

D. If existing property stakes, not within the limits of the trench, are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be

made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

E. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work, and will be held responsible for any error resulting from its failure to exercise such precaution.

F. See Specifications for additional requirements concerning layout of the Work.

1.04 PROGRESS MEETINGS

A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.

B. CONTRACTOR's project manager, job superintendent, major subcontractors and suppliers shall attend as appropriate to agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.

C. At the meetings, CONTRACTOR shall submit typed reports detailing progress of the Work, compliance with submitted progress schedules and future construction plans affecting the schedule of the Work.

D. ENGINEER will prepare and distribute minutes to all attending parties.

1.05 PREINSTALLATION MEETING

A. When required in individual specification sections, CONTRACTOR shall convene a preinstallation meeting at Work Site prior to commencing Work of the section.

B. CONTRACTOR shall require attendance of parties directly affecting, or affected by, work of the specific section.

C. CONTRACTOR shall notify ENGINEER seven days in advance of meeting date.

D. CONTRACTOR shall prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. CONTRACTOR shall record minutes and distribute copies within two days after meeting to participants, with two copies to ENGINEER, participants, and those affected by decisions made.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01045

CUTTING, PATCHING AND ALTERATIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: CONTRACTOR shall be responsible for all cutting, fitting, patching, and other alterations required to complete the Work as specified herein or to:
   1. Make its several parts fit together properly.
   2. Uncover portions of the Work to install improperly sequenced Work.
   3. Remove and replace defective Work.
   4. Remove and replace Work not conforming to requirements of the Contract Documents.
   5. Remove samples of installed Work as specified for testing.
   6. Provide penetrations of surfaces for installation of piping and electrical conduit.

1.02 REFERENCES

A. ANSI A10 Safety Requirements for Construction and Demolition.

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall perform all cutting, patching, and alterations in strict accordance with pertinent requirements of these Specifications.

B. Except as modified by governing codes, CONTRACTOR shall comply with the applicable provision and recommendations of ANSI A10.

1.04 SUBMITTALS

A. CONTRACTOR shall submit a written request to OWNER well in advance of executing any cutting or alteration which affects the following:
   1. Work of OWNER or any separate contractor.
   2. Structural value or integrity of any element of the Project.
   3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
   4. Efficiency, operational life, maintenance, or safety of operational elements.
   5. Visual qualities of sight-exposed elements.

B. The request shall include:
   1. Description of affected work.
   2. The necessity for cutting, patching, or alteration.
   3. Effect on work of OWNER or any separate contractor, or on the structural or weather-proof integrity of the Project.
   4. Description of proposed work to include:
      a. Scope of cutting, patching, or alteration.
      b. Trades who will execute the work.
      c. Products proposed to be used.
      d. Extent of refinishing to be done.

5. Alternatives to cutting and patching.
6. Written permission of any separate contractor whose work will be affected.

C. Submit written notice to OWNER designating the date and the time the Work will be uncovered or executed.

1.05 SCHEDULING AND COORDINATION

A. All work under this section shall be coordinated with OWNER's work forces and those of other contractors and shall be accomplished at times acceptable to OWNER.

B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service, notify ENGINEER and OWNER 72 hours in advance and obtain OWNER's approval before proceeding with this phase of the work. Temporary facilities, if required, shall be in place prior to disruption of service.

PART 2–PRODUCTS

2.01 NEW MATERIALS

A. For replacement of work removed, CONTRACTOR shall use materials which comply with the pertinent sections of these Specifications.

PART 3–EXECUTION

3.01 PREPARATION AND PROTECTION

A. CONTRACTOR shall provide temporary bracing, shoring, needling, and support of the structure during alterations work as necessary to prevent collapse, settling, or deflection and to protect persons and property from injury or damage.

B. Temporary supports must adequately carry all existing and imposed load.

C. CONTRACTOR shall provide and maintain temporary protection of surface finishes, equipment, and adjacent work designated to remain where demolition, removal, and new work is being done, connections are being made, materials are being handled, or equipment is being removed.

D. CONTRACTOR shall provide temporary partitions or barriers to contain all dust, dirt and debris from entering into finished areas or areas where OWNER is storing, or products.

E. CONTRACTOR shall provide adequate fire protection in accordance with local Fire Department requirements.

F. CONTRACTOR shall provide waterproofing, weather protection, heat, and other facilities for that portion of the work which may be exposed by cutting and patching, demolition, or other alterations.

3.02 PERFORMANCE

A. CONTRACTOR shall accomplish all work of cutting, removal, demolition, patching or other alterations using only persons skilled in the appropriate trade.

B. CONTRACTOR shall execute the work in a careful and orderly manner.

C. CONTRACTOR shall execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

D. CONTRACTOR shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

E. CONTRACTOR shall fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

F. CONTRACTOR shall thoroughly clean and prepare all surfaces to receive new finish or covering to completely remove all dirt, dust, grease, oil, paint, loose materials, and soil.

G. CONTRACTOR shall refinish entire surface as necessary to provide an even finish to match adjacent finishes:
   1. For continuous surfaces, refinish to nearest intersection.
   2. For an assembly, refinish entire unit.

3.03 DEMOLITION, CUTTING, AND REMOVAL

A. Cutting and removal of construction shall be performed by CONTRACTOR so as not to cut or remove more than is necessary and so as not to damage adjacent work.

B. CONTRACTOR shall cut out embedded anchorages and attachment items as required to properly provide for patching and repair of the respective finishes.

C. CONTRACTOR shall not cut structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.

D. CONTRACTOR shall not cut operational elements and safety components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.

E. CONTRACTOR shall not cut work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of visual qualities as determined by OWNER.

F. Construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of careless cutting or demolition and is unsuitable for use intended shall be removed and replaced at no additional cost to OWNER.

G. CONTRACTOR shall clean demolished areas and remove debris, waste, and rubbish from the building at the conclusion of each day's work.

H. CONTRACTOR shall not let piled waste material endanger the structure.

3.04 PATCHING, EXTENDING, AND MATCHING

A. Patching work shall conform to the standards of the Specifications where applicable and where not specified, work shall conform to the highest standards of the applicable trade.

B. CONTRACTOR shall patch construction to match adjacent work unless noted otherwise.

C. Patching or restoration shall be carried to natural breaks (e.g., corners) wherever possible.

D. CONTRACTOR shall provide adequate support to substrate for patching finishes.

E. Transitions:
   1. CONTRACTOR shall restore existing work that is damaged during patching operations to a condition equal to its construction at the time of the start of work.

END OF SECTION

SECTION 01060

REGULATORY REQUIREMENTS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. OSHA Requirements.
   2. Roadway Limits.
   3. Permits.
   4. Wage Rates.

1.02 OSHA REQUIREMENTS

A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act" (OSHA), the Kentucky Occupational Safety and Health Act (KYOSH), Franklin County, and all other applicable federal, state, county and local laws, ordinances, codes, the requirements set forth herein, and any regulations that may be specified in other parts of these Contract Documents. Where any of these are in conflict, the more stringent requirements shall be followed.

B. The CONTRACTOR's failure to thoroughly familiarize itself with the aforementioned safety provisions shall not relieve CONTRACTOR from compliance with the obligations and penalties set forth therein.

1.03 ROADWAY LIMITS

A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

A. The following permits were obtained by OWNER:
   1. Kentucky Division of Water
   2. Kentucky Department of Transportation Encroachment Permit

   They are included as attachments to this division. CONTRACTOR shall comply with all provisions of these permits, assume the responsibilities and requirements of the permits until the Project is accepted as complete by the OWNER, and shall be responsible for notifications as required by these permits. CONTRACTOR shall obtain all other permits required for the Work and comply with the requirements therein. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.

1.05 WAGE RATES

A. A state wage rate determination is not a requirement of this project.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01090

REFERENCE STANDARDS AND DEFINITIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Reference Standards:
      a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
      b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
      c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.
   2. Definitions:
      a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
      b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
      c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.

B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Familiarity with Pertinent Codes and Standards:
   1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
   2. When required by individual sections of these specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.

B. Overlapping or Conflicting Requirements:
   1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is

generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

1.03 REFERENCE STANDARDS

A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See Article 3.3 of the General Conditions for additional provisions regarding references.

B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.

C. Nonreference standards are hereby defined to have no particular applicability to the work except as a general measurement of whether the Work complies with standards recognized in the construction industry.

D. Reference standards and codes listed in these specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA — Aluminum Association
900 19th Street, NW, Washington, DC 20006

2. AAMA — American Architectural Manufacturer's Association
1827 Walden Office Square, Schaumberg, IL 60173

3. AASHTO — American Association of State Highway & Transportation Officials
444 North Capitol Street, NW, Washington, DC 20001

4. ACI — American Concrete Institute
38800 Country Club Drive, Farmington Hills, MI 48331

5. AI — Asphalt Institute
Research Park Drive, P.O. Box 14052, Lexington, KY 40512-4052

6. AISC — American Institute of Steel Construction
One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001

7. AISI — American Iron and Steel Institute
1101 17th Street, NW, Suite 1300, Washington, DC 20036

8. ANSI — American National Standards Institute
11 West 42nd Street, New York, NY 10036

9. APA — American Plywood Association
7011 So. 19th, Tacoma, WA 98466

10. API — American Petroleum Institute
12201 L Street, NW, Washington, DC 20005-4070

11. ARI — Air-Conditioning & Refrigeration Institute
4100 N. Fairfax Drive, Suite 200, Arlington, VA 22203

12. ASHRAE — American Society of Heating, Refrigerating, and Air Conditioning Engineers
1791 Tullie Circle, NE; Atlanta, GA 30329

13. ASME — American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

14. ASSE — American Society of Sanitary Engineering
901 Canterbury, Suite A, Westlake, OH 44145

15. ASTM — American Society for Testing and Materials
100 Barr Harbor Drive, West Conshohoken, PA 19428-2959

16. AWI — Architectural Woodwork Institute
1952 Isaac Newton Square West, Reston, VA 20190

17. AWPA — American Wood-Preserver's Association
P.O. Box 388, Selma, AL 36702-0388

18. AWS — American Welding Society
550 N.W. LeJune Road, Miami, FL 33126

19. AWWA — American Waterworks Association
6666 West Quincey Avenue, Denver, CO 80235

20. BHMA — Builder's Hardware Manufacturers Association
355 Lexington Avenue, 17th floor; New York, NY 10017

21. BIA — Brick Industry Association
11490 Commerce Park Drive, Reston, VA 20191-1525

22. CRSI — Concrete Reinforcing Steel Institute
9333 N. Plum Grove Road, Schaumburg, IL 60173

23. EJMA — Expansion Joint Manufacturers Association
25 North Broadway, Tarrytown, NY 10591

24. FM — Factory Mutual System
FM Global Corporate Offices, 1301 Atwood Avenue, PO Box 7500, Johnston, RI 02919

25. FS — Federal Specification (General Services Admin.)
Bldg. 197, Washington Navy Yard; Washington, DC 20407

26. FTI — Facing Tile Institute
Box 8880, Canton, OH 44711

27. GA — Gypsum Association
810 1st St., NE, Washington, DC 20002

28. GANA — Glass Association of North America
2945 SW Wanamaker Drive, Suite A, Topeka, KS 66614

29. IESNA — Illuminating Engineering Society of North America
120 Wall Street, Floor 17, New York, NY 10005

30. MIL — Military Specifications
Naval Publications and Forms Center
5801 Tabor Avenue, Philadelphia, PA 19120

31. NAAMM — National Association of Architectural Metal Manufacturers
8 South Michigan Avenue, Suite 1000, Chicago, IL 60603

32. NCMA — National Concrete Masonry Association
13750 Sunrise Valley Drive, Herndon, VA 20171-4662

33. NECA — National Electrical Contractors Association
3 Bethesda Metro Center, Suite 1100, Bethesda, MD 20814

34. NEMA — National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847, Rosslyn, VA 22209

35. NFPA — National Fire Protection Association
1 Batterymarch Park, Quincy, MA 02169-7471

36. NIS — National Institute of Standards
(U.S. Department of Commerce), 100 Bureau Drive, Stop 3460
Gaithersburg, MD 20899-3460

37. NRCA — National Roofing Contractors Association
10255 W. Higgins Road, Suite 600, Rosemont, IL 60018

38. NSF — National Sanitation Foundation International
P.O. Box 130140, 789 N. Dixboro Road, Ann Arbor, MI 48113-0140

39. OSHA — Occupational Safety & Health Administration
200 Constitution Avenue, NW, Washington, DC 20210

40. PCA — Portland Cement Association
5420 Old Orchard Road, Skokie, IL 60077

41. PCI — Prestressed Concrete Institute
209 W. Jackson Blvd., Chicago, IL 60606-6938

42. SAE — Society of Automotive Engineers
SAE World Headquarters
400 Commonwealth Drive, Warrendale, PA 15096-0001

43. SDI — Steel Deck Institute
P.O. Box 25, Fox River Grove, IL 60021

44. SDI — Steel Door Institute
30200 Detroit Rd., Cleveland, OH 44145-1987

45. SIGMA — Sealed Insulating Glass Manufacturers Assoc.
401 N. Michigan Avenue, Chicago, IL 60611-4267

46. SJI — Steel Joist Institute
3127 10th Ave. North Ext., Myrtle Beach, SC 29577-6760

47. SMACNA — Sheet Metal and Air Conditioning
Contractor's National Association
4201 Lafayette Center Drive, Chantilly, VA 20151-1209

48. SSPC — Society for Protective Coatings
40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656

49. TCA — Tile Council of America
100 Clemson Research Blvd., Anderson, SC 29625

50. UBC — Uniform Building Code
5360 Workman Mill Road; Whittier, CA 90601-2298

51. UL — Underwriters' Laboratories
333 Pfingston Road; Northbrook, IL 60062

1.04 SUBMITTALS

A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

1.05 DEFINITIONS

A. Indicated:
1. The term "indicated" is a cross-reference to details, notes, or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents.
2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.

B. Approve (or Words of Similar Nature):
1. Where used in conjunction with ENGINEER's response to submittals, requests, applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in Paragraph 2.9 of the General Conditions.
2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.

C. CONTRACTOR: If anywhere in these Contract Documents, General, Mechanical, Plumbing or Electrical Contractor is mentioned, it shall be considered to mean General Contractor for this Contract.

D. Minimum Requirements:
   1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
   2. Actual work must comply with (or within specified tolerances) or exceed minimums.
   3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.

E. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
   2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
   3. The type of submittal requirements specified in this section include shop drawings, product data, samples, and other miscellaneous work related submittals.

B. Related work described elsewhere: Additional requirements for submittals are described in other sections of these specifications. Submittals shall conform to Article 6 of the General Conditions.

1.02 IDENTIFICATION OF SUBMITTALS

A. CONTRACTOR shall completely identify each submittal and re-submittal by showing at least the following information:
   1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
   2. Name and location of project and identification number.
   3. Drawing number and specifications section number to which the submittal applies.
   4. Include the date of each submittal or re-submittal.

1.03 GROUPING OF SUBMITTALS

A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.

B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

1.04 TIMING OF SUBMITTALS

A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and re-submittal and for placing orders and securing delivery.

1.05 SHOP DRAWINGS

A. Shop drawings include specially-prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard

printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.

B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.

C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to ENGINEER for review and approval.

D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 25% completion of the Work. Except as noted, six copies of shop drawings and descriptive data shall be submitted to ENGINEER for approval. Three copies of these will be returned to CONTRACTOR if approved. If shop drawings are not approved or if they are stamped "Approved as Noted-Resubmit," two corrected copies will be returned to CONTRACTOR for use in resubmittal. If CONTRACTOR desires more than three approved copies, submitted quantity shall be increased accordingly.

E. When shop drawing sheets have both border dimensions exceeding 11 inches, shop drawings shall be submitted in a reduced size suitable for binding. Reduced shop drawings shall have sheet dimensions as large as practical to avoid over-reduction, but shall have either a vertical or horizontal border dimension of 11 inches or less. This requirement does not apply to reinforcing and structural steel shop drawings and general arrangement drawings for piping.

F. Shop drawings shall be submitted in 3-tab report covers, binder clips, or large envelopes.

G. Shop drawings submitted to ENGINEER will be reviewed and stamped "Approved," "Approved as Noted," "Approved as Noted-Resubmit," or "Not Approved." CONTRACTOR shall resubmit the above number of corrected shop drawings for all shop drawings stamped "Approved as Noted-Resubmit" and "Not Approved" and will continue this process until shop drawings are stamped "Approved" or "Approved as Noted." If drawings are stamped "Approved as Noted-Resubmit," fabrication may proceed in accordance with the marked up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped "Approved" or "Approved as Noted."

H. If shop drawings are stamped "Approved as Noted" or "Approved as Noted-Resubmit" and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR's position.

I. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.

J. Arrangements may be made between CONTRACTOR and ENGINEER to provide additional copies of "Approved" shop drawings for field activity purposes.

1.06 COLORS AND PATTERNS

A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product CONTRACTOR

shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.

B. Unless all available colors and patterns have identical wearing capabilities, and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

1.07 SAMPLES AND FIELD MOCK-UPS

A. CONTRACTOR shall provide samples and field mock-ups where noted or specified.

B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.

C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product, and full range of color, texture, and pattern.

D. Samples shall have labels firmly attached, bearing the following information:
   1. Name of project.
   2. Description of product and finish.
   3. Name of CONTRACTOR.
   4. Trade name and number of product.
   5. Standards met by the product.

E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.

F. Samples, unless otherwise noted, become the property of OWNER.

G. In situations specifically approved by ENGINEER, the retained sample may be used in the construction as one of the installed items.

H. Field mock-ups:
   1. CONTRACTOR shall erect field mock-ups at the project site in a location acceptable to ENGINEER and OWNER.
   2. When accepted by ENGINEER, the mock-up will become the basis for comparison of the actual work.
   3. Remove mock-up at conclusion of the work if it was not incorporated into the work.

1.08 PRODUCT DATA

A. CONTRACTOR shall provide product data as required to supplement shop drawings.

B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.

C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.

D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and

piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.

E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.

F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

1.09 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in the submittals required by ENGINEER.

B. Shop Drawings and Product Data:
   1. Revise initial drawings or data and resubmit as specified for initial submittal.
   2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.

1.10 MANUFACTURER'S DIRECTIONS

A. Manufactured articles, materials and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer, unless specified to the contrary.

B. Wherever specifications call for work to be performed, or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to ENGINEER before installing the material or performing the work.

1.11 MAINTENANCE MANUAL

A. Prior to 50% completion of the Contract, CONTRACTOR shall furnish to ENGINEER four complete copies of a maintenance manual for all equipment furnished.

B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.

C. All sheets shall have reduced dimensions as described for shop drawings. Only one copy shall be submitted in a 3-ring binder or 3-tab report cover, and the remaining copies shall be furnished in 3-tab report covers, binder clips, or large envelopes.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1–GENERAL

1.01 SUMMARY

A. Work Includes:
   1. Quality assurance–control of installation.
   2. Tolerances
   3. Manufacturers' field services and reports.

1.02 QUALITY ASSURANCE–CONTROL OF INSTALLATION

A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.

D. CONTRACTOR shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Work shall be performed by persons qualified to produce workmanship of specified quality.

F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.

B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from ENGINEER before proceeding.

C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.

C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Temporary utilities.
   2. Temporary stairs and access.
   3. Temporary support facilities.
   4. Construction sign.
   5. Removal of temporary facilities.

B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.

C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.

D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
   1. Furnish all necessary labor and materials.
   2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
   3. Maintain such connections.
   4. Remove temporary installation and connection when no longer required.
   5. Restore services and sources of supply to proper operating conditions.

1.02 TEMPORARY UTILITIES

A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.

B. Temporary Electrical Services:
   1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. Services shall be a minimum of 200 amperes, 1 phase, 3 wire, 120/240 volt temporary power and lighting system adequate for the construction of this Project and in accordance with OSHA Requirements for Construction Projects. Installation of the temporary power and lighting system is to begin upon notification to proceed and shall be installed and routed in a manner so as not to interfere with construction of the Project. CONTRACTOR shall remove all temporary services when Project is complete.
   2. The temporary light and power system shall include temporary service poles, metering facilities, driven ground, fused main disconnect switch, panelboards, branch circuits, outlets and lamps, and the maintenance thereof.

3. Construction areas, aisles, stairs, and ramps shall be illuminated to 5 fc. Construction shops, storerooms, mechanical, and electrical rooms shall be illuminated to 10 fc. Offices illuminated to 30 fc.
4. Temporary lights shall be equipped with heavy-duty electric cords and lamp guards. They must not be suspended by the power supply cord unless it is designed for this use.
5. Provide one general purpose, 20 ampere, 120 volt, single phase, grounding type receptacle outlet for every 1,000 feet of floor space and tank area. The maximum length of a 20 ampere, 120 volt lighting or power circuit shall not be greater than 200 feet from panelboard to farthest outlet. All single phase receptacle outlet circuits shall have approved ground-fault circuit interrupter protection.
6. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
7. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.

C. Weather Protection and Temporary Heat:
1. CONTRACTOR shall provide weather protection to protect the Work from injury because of freezing, rain, snow, and other inclement weather.
2. CONTRACTOR shall provide temporary heat within buildings, without cost to OWNER, from the time the buildings or portions thereof are enclosed until the Project is accepted or occupied by OWNER, whichever occurs first. The building work is to be heated during construction so a minimum temperature of 50°F is maintained at all times. The temporary heating equipment shall be of a type approved by ENGINEER.
3. Tanks that are constructed and existing tanks taken out of service as part of the Work shall be protected by CONTRACTOR from damage because of frost by insulating, enclosure, heating, or a combination of methods as required.
4. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.

D. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.

E. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.

1.03 TEMPORARY STAIRS AND ACCESS

A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.

B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.

C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.

D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

1.04 TEMPORARY SUPPORT FACILITIES

A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.

B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

1.05 CONSTRUCTION SIGN

A. Furnish and erect a construction sign to be maintained and kept in place until completion of the Contract.

B. The sign shall be minimum 4-feet high by 8-feet wide, constructed by a professional sign painter, and shall show the name of the Project, OWNER, all prime contractors and ENGINEER. ENGINEER will furnish a sketch showing the printing and colors of paint required. General sign layout shall be as shown on Drawing 01-975-158A attached at the end of these Specifications.

1.06 REMOVAL OF TEMPORARY FACILITIES

A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to final completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01560

TEMPORARY CONTROLS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Dust control.
   2. Water, erosion and sediment control.
   3. Noise control.
   4. Traffic control.
   5. Site security.
   6. Daily cleanup.
   7. Pollution control.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DUST CONTROL

A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.

B. CONTRACTOR shall provide positive means to prevent air-borne dust from dispersing into atmosphere.

C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

3.02 WATER, EROSION AND SEDIMENT CONTROL

A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. CONTRACTOR shall protect Site from puddling or running water.

C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.

D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.

E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.

F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.

G. Erosion control measures shall comply with the following document: Kentucky's Best Management Practices for Construction Activities.

3.03 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

3.04 TRAFFIC CONTROL

A. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen and other traffic control devices in the construction zone.

B. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen and other traffic control devices in the construction zone. All traffic control measures shall meet the requirements Manual on Uniform Traffic Control Devices for Streets and Highways, Latest Edition.

C. Do not close or obstruct roadways without approval of OWNER.

D. Maintain two-way traffic on streets at all times.

E. Conduct operations with minimum interference to roadways.

3.05 SITE SECURITY

A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.

B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

3.06 DAILY CLEANUP

A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.

B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Temporary field offices and sheds.
   2. Maintenance and cleaning.
   3. Removal.

PART 2–PRODUCTS

2.01 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, equipment and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

A. Portable or mobile buildings, or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.

C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.

D. Exterior materials shall be weather resistant.

E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.

F. Lighting for offices shall be 50-foot candles minimum at desk top height, with exterior lighting at entrance doors.

G. Provide appropriate type fire extinguisher at each office and each storage area.

H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

2.03 ENVIRONMENTAL CONTROL

A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.

B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

2.04 CONTRACTOR OFFICE AND FACILITIES

A. CONTRACTOR shall provide facilities to meet CONTRACTOR's needs and to provide space for Project meetings.

B. Provide telephone as required for CONTRACTOR's needs.

C. Provide furnishings in meeting area. As a minimum, provide conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.

2.05 STORAGE AREAS AND SHEDS

A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01600–Materials and Equipment.

PART 3–EXECUTION

3.01 PREPARATION

A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

A. CONTRACTOR shall install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed or as agreed upon by ENGINEER.

B. Provide two hard surfaced parking spaces for use by ENGINEER, connected to office by hard surfaced walk.

3.03 MAINTENANCE AND CLEANING

A. CONTRACTOR shall provide weekly janitorial services for offices and periodic cleaning and maintenance for office and storage areas.

B. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

3.04 REMOVAL

A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris, and shall restore areas.

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.

B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

1.02 PRODUCTS

A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.

B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.

C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

1.03 TRANSPORTATION AND HANDLING

A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.

B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.

C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.

D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.

E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

1.04 DELIVERY AND RECEIVING

A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.

B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.

C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.

D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.

E. Immediately on delivery, CONTRACTOR shall inspect shipment to assure:
   1. Product complies with requirements of Contract Documents and reviewed submittals.
   2. Quantities are correct.
   3. Accessories, and installation hardware are correct.
   4. Containers and packages are intact and labels legible.
   5. Products are protected and undamaged.

1.05 STORAGE AND PROTECTION

A. General:
   1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
   2. Available storage space at the Site is limited. Any additional off-site space required shall be arranged by CONTRACTOR.
   3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
   4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.

B. In enclosed storage, CONTRACTOR shall:
   1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
   2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
   3. Provide ventilation for sensitive products as required by manufacturer's instructions.
   4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
   5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
   6. Store liquid materials away from fire or intense heat and protect from freezing.

C. At exterior storage, CONTRACTOR shall:
   1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
   2. Store tools or equipment that carry dirt outside.
   3. Store large equipment so as not to damage the Work or present a fire hazard.

4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.
5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

1.06 MAINTENANCE OF STORAGE

A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.

B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.

C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

1.07 INSTALLATION REQUIREMENTS

A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.

B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.

C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

1.08 CONCRETE EQUIPMENT BASE

A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3-1/2 inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.

B. Concrete and grout shall meet applicable sections of the specifications.

C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Starting equipment and systems.
   2. Demonstration and instructions.
   3. Testing, adjusting, and balancing.

B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 STARTING EQUIPMENT AND SYSTEMS

A. Coordinate schedule for start up of various equipment and systems.

B. Notify ENGINEER and OWNER a minimum of seven days prior to start up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.

G. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start up, and to supervise placing equipment or system in operation.

H. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.

I. Provide lubricants as recommended by manufacturer appropriate for start up conditions.

1.03 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to OWNER's personnel.

B. For all mechanical equipment or systems, demonstrate project equipment and instruct in a classroom environment at a location acceptable to the OWNER and instructed by a qualified manufacturers' representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for noncurrent season at start of noncurrent season.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. Supervision and Start Up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation by a qualified representative of the equipment manufacturer and the staff shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.

H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

1.04 START UP AND TESTING

A. Prior to acceptance of any portion of the Work, start up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.

B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start up and testing operations shall include, but not be limited to, temporary piping and electrical equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices or items that may be required for start up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.

C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start up and testing.

PART 2--PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Closeout procedures.
   2. Final cleaning.
   3. Adjusting.
   4. Project record documents.
   5. Warranties.
   6. Spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.

B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work, or designated portion thereof, for substantial completion.
   1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
   2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
   3. Submit consent of surety (if surety required in Contract).
   4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

1.03 FINAL CLEANING

A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.

B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work, and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
   1. Removal of trash and rubbish from these areas.
   2. Broom cleaning of floors.
   3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.

C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:

1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
3. Replace filters of operating equipment.
4. Clean debris from roofs, gutters, downspouts, and drainage systems.
5. Clean site; sweep paved areas, rake clean landscaped surfaces.
6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

1.04 ADJUSTING

A. CONTRACTOR shall adjust operating products and equipment to ensure smooth and unhindered operation.

1.05 PROJECT RECORD DOCUMENTS

A. CONTRACTOR shall maintain on Site, one set of the following record documents to record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. CONTRACTOR shall ensure entries are complete and accurate, enabling future reference by OWNER.

C. CONTRACTOR shall store record documents separate from documents used for construction.

D. CONTRACTOR shall record information concurrent with construction progress.

E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by addenda and modifications.

F. Record Documents and Shop Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

1.06 WARRANTIES

A. CONTRACTOR shall provide warranties beyond project one year warranty as required by technical sections and as follows.

B. Submit warranty information as follows:
   1. Provide notarized copies.
   2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three ring binder with durable cover.
   3. Submit with request for certificate of Substantial Completion.
   4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

A. CONTRACTOR shall provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

PERMITS

SECTION 02110

SITE CLEARING AND STRIPPING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Removal of surface debris.
   2. Removal of trees, shrubs, and other plant life.
   3. Strip and stockpile topsoil.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment:
   1. Payment for site clearing and stripping shall be included in the unit price bid.
   2. Topsoil removal and stockpiling shall be considered unclassified excavation.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 PREPARATION

A. CONTRACTOR shall identify existing plant life to remain and shall tag accordingly.

3.02 PROTECTION

A. CONTRACTOR shall protect from damage utilities that are to remain.

3.03 CLEARING AND GRUBBING

A. Clearing and grubbing shall consist of cutting and disposing of trees, brush, windfalls, logs, and other vegetation and the removing and disposing of roots, stumps, stubs, grubs, logs, and other timber from within the clearing limits as defined on the drawings designated to be removed on the drawings or in the specifications or fall within the excavation, embankment, or improved areas of the site.

B. All roots and stumps shall be removed to a depth of not less than 12 inches below the original ground surface in embankment areas. In cut areas, such material shall be removed to a depth of not less than 12 inches below the subgrade.

3.04 REMOVALS

A. CONTRACTOR shall remove from the site all trees, brush, and other vegetation, debris, and rocks which fall within the excavation and grading limits.

3.05 STRIPPING

A. Excavate topsoil from areas to be built upon, cut or filled, or to have surface improvements, including roadways and walks.

B. Stockpile topsoil on-site and protect from erosion.

C. OWNER maintains first claim against excess topsoil.

D. If OWNER waives claim to excess topsoil, remove it from the site.

END OF SECTION

SECTION 02140

DEWATERING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Removal of groundwater to allow below grade construction.
   2. Site grading to prevent surface water from entering the excavation.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment:
   1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
   2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.

1.02 REFERENCES

A. See Division 1, Regulatory Requirements, for permit requirements and water, erosion, and sediment control.

1.03 SYSTEM REQUIREMENTS

A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. Unless otherwise approved, no water shall flow over the work until the joints are complete or the concrete has set.

B. Dewatering shall be sufficient to lower the piezometric level to at least two feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.

C. In areas where rock is encountered, the water level shall be kept at or below top of rock but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.

D. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.

E. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

1.04 QUALITY ASSURANCE

A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 DEWATERING

A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.

B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.

C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.

D. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

3.02 PROTECTION

A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.

B. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences and businesses to the greatest extent possible by using electric-driven pumps, intake and exhaust silencers, or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

SECTION 02222

EXCAVATION, FILL, BACKFILL, AND GRADING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
   1. Excavating for footings, foundations, roads, and utilities.
   2. Placing and compacting all fill and backfill.
   3. Placement of granular mat vapor barrier and granular cushion below interior slabs on grade.
   4. Placement of crushed stone mat below tank slabs and manhole/vault slabs, basement floors, or other structures where required.
   5. Rough and finish grading prior to paving, seeding, etc.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment:
   1. General excavation shall include all excavation specified, undercutting, fill, backfill, and grading, including rock excavation but not including unsuitable foundation material as hereinafter described.
   2. All general excavation shall be included in the Lump Sum Bid. Changes which require additions to or deductions from the excavation will be adjusted on the basis of the unit price for changes contained in the Contract.

1.02 REFERENCES

A. ASTM D1557–Test Methods for Moisture Density Relations of Soils and Soil–Aggregate Mixtures using 10-pound Rammer and 18-inch drop.

B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Kentucky, Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications. Unless specifically stated otherwise, the Measurement and Payment sections of the Standard Specifications shall not apply. Measurement and payment will be made in accordance with terms of the Contract Documents.

1.03 SUBMITTALS

A. CONTRACTOR shall submit samples of materials proposed for use as fill to soils testing laboratory for analysis of their suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.

B. CONTRACTOR shall submit sufficient samples of each different type or classification of soil to obtain representative values.

1.04 JOB CONDITIONS

A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.

B. Soil borings were made, and the logs are included in the Appendix to these Specifications. The information contained on the borings is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations. The complete soil report is available for review at the office of ENGINEER.

PART 2–PRODUCTS

2.01 COMPACTED FILL

A. All fill and backfill material designated to be compacted fill shall be open graded No. 57 stone.

2.02 CRUSHED STONE MAT

A. Crushed stone mat where called out below slabs shall be 1-inch clear crushed stone and shall meet all requirements for No. 57 of Section 805 of Standard Specifications.

2.03 GRANULAR CUSHION

A. Granular cushion beneath floor slabs-on-grade shall meet requirements for 3/4-inch dense graded aggregate of Section 805 of Standard Specifications.

2.04 EMBANKMENT FILL

A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

2.05 CONCRETE FILL

A. Concrete fill shall be Class X concrete as defined in Section 03300 Cast-In-Place Concrete.

2.06 CLAY FILL

A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

2.07 FLOWABLE FILL

A. Flowable fill shall be a self-compacting, self-leveling material consisting of a mixture of fine aggregate and filler (as needed), water, and cementitious materials (Portland Cement, fly ash, granulated blast furnace slag) that is in a flowable state at the time of placement meeting the requirements of the National Ready Mixed Concrete Association Guide Specification for Controlled Low Strength Materials (CLSM). The Flowable fill shall be proportioned by the ready mixed concrete supplier on the basis of field experience and/or

laboratory trial mixtures to produce a cohesive and non-segregating mixture which has the following properties:

1. Minimum compressive strength--150 psi.
2. Maximum unit weight–85 pcf.

B. CONTRACTOR shall submit the following information well in advance of fill placement to avoid any delay in construction:

1. Gradation of fine aggregate.
2. Design mix.
3. Previous test results with 7- and 28-day compressive strengths.
4. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
5. Brand, type, principle ingredient, and amount of each admixture if used.

PART 3–EXECUTION

3.01 GENERAL

A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

3.02 PROTECTION

A. CONTRACTOR shall provide all necessary sheeting and shoring including all labor, material, equipment, and tools required or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheet piling and timbers in excavations shall be withdrawn in a manner so as to prevent subsequent settlement of structures.

B. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

3.03 UTILITIES

A. Before starting excavations, CONTRACTOR shall locate existing underground utilities in all areas of the work.

B. If utilities are to remain in place, CONTRACTOR shall provide adequate means of protection during earthwork operations.

C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions.

D. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation and repair any damaged utilities to satisfaction of utility owner.

E. CONTRACTOR shall not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.

F. CONTRACTOR shall demolish and completely remove from the site existing underground utilities indicated to be removed after utility has been capped and sealed.

G. CONTRACTOR shall accurately locate and record abandoned and active utility lines rerouted or extended on project record drawings.

3.04 FINISH ELEVATIONS AND LINES

A. CONTRACTOR is responsible for setting and establishing finish elevations and lines.

3.05 EXCAVATION

A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.

B. All excavated material which does not meet the specification for compacted fill or embankment fill, or meets the specification but is not required for backfill or fill, shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.

C. OWNER maintains first claim against all excess material. If OWNER chooses to utilize this option, CONTRACTOR shall place the excess material on the site in locations as designated by OWNER. If OWNER desires to keep the excess material but have it removed to a remote site, the hauling cost shall be at the OWNER's expense unless otherwise specified.

D. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.

E. Excavation for all footings, foundation walls, pits, etc. shall be large enough to provide adequate clearance for the proper execution for the work within them.

F. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 02140–Dewatering.

G. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.

H. When excavations reach subgrade elevations as shown on the drawings, or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.

I. Excavations for strip footings at the pump station building shall be undercut approximately 3 feet by 4 feet, or until weathered rock is encountered. Excavation shall then be filled with concrete fill up to foundation base elevation.

J. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation one foot plus a distance at least equal to the depth of undercut below footing grade.

K. CONTRACTOR shall backfill and compact all overexcavated areas.

L. For slab-on-grade construction under electrical room and generator room of pump station building, there shall be a minimum of 1 foot of soil cushion between crushed stone base and rock. If less than 1 foot of soil exists between crushed stone and rock, the rock shall be undercut and 1 foot of structural fill shall be placed.

3.06 PREPARATION OF SUBGRADE

A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.

B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.

C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.

3.07 COMPACTED FILL AND BACKFILL

A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.

B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.

C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.

D. No fill shall be placed under water or over unsuitable subgrade conditions.

E. All fill and backfill except embankment fill and clay fill shall be compacted as follows:
   1. Class 1 Compaction–This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within ten feet of structure walls. All compacted material shall be placed in uniform layers not exceeding eight inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
   2. Class 2 Compaction–This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least

90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.

F. No frozen material shall be placed nor shall any material be placed on frozen ground.

G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

3.08 EMBANKMENT FILL

A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.

B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment and, in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

3.09 CONCRETE FILL

A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, Class X concrete shall be used as fill material.

3.10 GRADING

A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the drawings.

B. Grading Tolerances:
1. Rough Grade: Buildings, parking areas, drainage ditches, and sidewalks–±0.1 feet.
2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs–±0.03 feet.
3. Lawn areas away from buildings, parking areas, and sidewalks–±0.25 feet.

3.11 PLACING GRANULAR CUSHION AND VAPOR BARRIER

A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place the vapor barrier.

B. A 6-inch layer of granular cushion shall then be placed, compacted, and finish graded.

3.12 PLACING CRUSHED STONE AND GEOTEXTILE FABRIC

A. The same day that the subgrade is exposed, place geotextile fabric on unpaved entrance and turnaround subgrade as shown on the construction drawings, and place 12 inches of crushed stone mat below manholes, vault slabs, and basement floors. Compact in place.

3.13 COMPACTION TESTING

A. Compaction tests shall be done by the Project Soils Engineer. Location and frequency of the tests shall be as recommended by the Project Soils Engineer and paid for by OWNER.

3.14 POTENTIALLY HAZARDOUS MATERIALS

A. If CONTRACTOR encounters during excavation or trenching activities, any potentially hazardous materials as defined in this section, and the materials are within the limits of the site excavation or trenching work, the materials shall be handled as specified in this section. Potentially hazardous materials are defined as any drums, containerized waste, or organic liquid waste or surrounding impacted material. Such materials have not been found during investigations performed to date but could potentially be encountered.

B. OWNER will provide CONTRACTOR special written notice specifying that the condition has been rendered safe for the resumption of excavation or trenching activities or specifying any special conditions under which the activities may be resumed. The cost of sampling and lab testing will be the responsibility of OWNER.

END OF SECTION

SECTION 02229

ROCK REMOVAL

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Removal of rock during excavation for structures and roads.
   2. Removal of rock during excavation for utility trenches.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment: Payment for rock excavation shall be included in lump sum bid.

1.02 DEFINITIONS

A. Rock excavation for structures, roads, and utility trenches shall include all hard, solid rock ledges, bedded deposits and unstratified masses, and all conglomerate deposits or any other material so firmly cemented that, in the opinion of ENGINEER, it is not practical to excavate and remove same with a 270 net flywheel horsepower tractor (Caterpillar D-8 with power shift or equal) equipped with dozer blade and hydraulic-mounted parallelogram ripper; 225 net flywheel horsepower hydraulic backhoe or equal, except after continuous drilling and blasting. No soft or disintegrated rock which can be removed with a pick; no loose, shaken, or previously broken rock; and no rock which may fall into the excavation from outside the limits of excavation will be classified as rock excavation. Rock excavation shall also include all rock boulders necessary to be removed having a volume of one cubic yard or more.

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall employ a seismic survey firm if explosives are to be used. Seismic survey firm shall be a company specializing in seismic surveys with five years documented experience.

B. If explosives are to be used, CONTRACTOR shall have five years experience or shall employ a firm with five years experience with use of explosives.

C. Blaster shall hold necessary licenses for the type of work performed.

1.04 REGULATORY REQUIREMENTS

A. CONTRACTOR shall conform to applicable federal, state, and local codes for explosive disintegration of rock, including the provisions of the Laws and Regulations Governing Explosions and Blasting, as issued by the Kentucky Division of Mines and Minerals, and the Kentucky OSHA Standards for the Construction Industry, Subpart U, Blasting as issued by the Kentucky Labor Cabinet.

B. CONTRACTOR shall obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

C. No explosives shall be used without written permission from OWNER.

1.05 PROJECT CONDITIONS

A. CONTRACTOR shall conduct survey and document conditions of buildings near locations of rock removal, both prior to and after blasting, in the presence of adjacent property owners and shall advise owners of adjacent buildings or structures in writing, prior to executing seismographic survey.

B. CONTRACTOR shall obtain a seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 ROCK REMOVAL

A. CONTRACTOR shall provide seismographic monitoring during progress of blasting operations.

B. Disintegrate rock and remove from excavation.

C. Remove rock at excavation bottom to form level bearing surface.

D. Rock shall be removed 2 feet below finish grade in areas to receive seed, sod, or trees.

E. Remove shaled layers to provide a sound and unshattered base for foundations.

F. Unauthorized rock removal shall be corrected in accordance with backfilling and compacting requirements of Section 02222–Excavation, Fill, Backfill and Grading or with concrete fill if required by ENGINEER.

G. All excavated rock shall be classified as undesirable backfill material and shall be disposed of as specified in Section 02222–Excavation, Fill, Backfill and Grading, unless it is crushed and screened to meet backfill requirements for use on site.

H. All excavations and trenches in rock shall be backfilled with approved backfill materials furnished by CONTRACTOR. Costs for such materials shall be included in the price bid for rock excavation.

END OF SECTION

SECTION 02231

AGGREGATE BASE COURSE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Aggregate base course for roads and parking areas.
   2. Gravel roads.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment: Payment for crushed aggregate base course shall be made at the unit price bid and shall include all labor, materials, and work necessary for complete installation. Payment will be made based on weight tickets delivered with each truck load of base course.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction, latest edition, including all issued supplemental specifications. Unless specifically stated otherwise, the Measurement and Payment sections of the Standard Specifications shall not apply. Measurement and payment will be made in accordance with terms of the Contract Documents.

1.03 DEFINITIONS

A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

A. Submit sieve analysis for proposed materials in accordance with Section 01300-Submittals.

1.05 DRAINAGE DURING CONSTRUCTION

A. CONTRACTOR shall comply with the provisions of Section 204 of the Standard Specifications.

PART 2–PRODUCTS

2.01 AGGREGATES

A. Aggregate for base course shall meet the requirements of dense grade aggregate of Section 302 of the Standard Specifications.

B. Base course shall be uniformly graded and shall conform to the requirements for DGA of Section 805 for the top 3 inches and Size No. 2 for the remaining depth of basecourse.

C. Material for top layer of shoulders shall conform to the requirements for DGA of Section 805.

D. Material to replace yielding or unstable subgrade shall conform to Size No. 2 of Section 805.

PART 3--EXECUTION

3.01 PREPARATION

A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the drawings. All street subgrade in cut areas and all areas to receive fill shall be proofrolled in the presence of OWNER or ENGINEER with a heavily loaded tri-axle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Section 207 of the Standard Specifications.

3.02 CONSTRUCTION

A. Base course grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.

B. Depth of base course shall be provided according to the typical sections provided on the Drawings.

C. Depth of base course shall be as shown in the construction Drawings.

D. Construction of base course shall conform to Section 302 of the Standard Specifications. Each layer of base course shall be wetted and rolled to provide maximum compaction in accordance with requirements therein.

E. The finished base course shall be fine graded in preparation for paving.

F. After final grading, CONTRACTOR shall maintain the base course until asphaltic paving work has been completed.

G. All gravel surfaces damaged during construction shall be replaced. The depth of aggregate shall match existing or 8 inches, whichever is greater.

END OF SECTION

SECTION 02240

GEOTEXTILES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Geotextiles for areas below structures, at perforated drain pipe trenches below base course, and below riprap.

B. Payment: Payment for geotextile shall be included in the applicable pay items as shown in the Drawings or noted in the specifications.

PART 2–PRODUCTS

2.01 MATERIALS

A. Geotextile for areas below structures, for use at perforated drain pipe trenches and as specified elsewhere, shall be Mirafi 140N, or equal.

B. Geotextile below riprap shall be Mirafi 600X, or equal.

C. Geotextile below base course shall be Mirafi 500X, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Geotextile shall be installed in accordance with manufacturer's recommendations.

B. Geotextile shall be lapped a minimum of 24 inches.

C. If extensive areas of unstable subgrade are encountered on street areas, ENGINEER may request the furnishing and installation of construction fabric to obtain the necessary subgrade support for the roadway structure. Vibratory compaction shall not be used in the compaction of base course in areas where construction fabrics are used.

D. CONTRACTOR shall protect the construction fabric from exposure to the sun until installation. Construction fabric shall be covered with stone or soil immediately upon placement.

END OF SECTION

SECTION 02270

SLOPE PROTECTION AND EROSION CONTROL

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Erosion control devices.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 PAYMENT

A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; for removing the fence at completion of project; for cleaning and repairing; for removing or spreading accumulated sediment to form a surface suitable for seeding; for replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and for furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

1.03 REFERENCES

A. Kentucky Best Management Practices for Construction Activity (Ky BMP).

1.04 REGULATORY REQUIREMENTS

A. CONTRACTOR is required to obtain any necessary federal, state, or local permits for erosion control. The permit requirements are CONTRACTOR's responsibility and shall be included in the prices Bid.

B. Comply with laws prohibiting pollution of any lake, stream, river, or wetland.

1.05 QUALITY CONTROL

A. Construct and maintain erosion sediment control measures in accordance with Ky BMP.

B. Check facilities weekly and after any rainfall event and make needed repairs within 24 hours.

PART 2–PRODUCTS

2.01 EROSION MATS

A. Uniform web of interlocking wood excelsior fibers with a net backing on one side. The wood from which the blanket is produced shall have been properly cured to achieve

adequately curled and barbed fibers. The blanket shall be of uniform thickness with the wood fibers evenly distributed over the entire area of the blanket. The blanket shall be furnished in rolled strips. The width of the strips shall be 48 inches, ±1-inch. Weight of blanket measured under average atmospheric conditions shall be 78 pounds per 80 square yards, ±10%. Net backing shall have mesh size not exceeding 1 1/2 by 3 inches and may be woven from twisted paper, cotton cord, a biodegradable plastic, or other alternate approved by ENGINEER. The blanket shall be nontoxic to vegetation.

2.02 SILT FENCE

A. Conform to Ky BMP as supplemented herein.

B. Use geotextile fabric consisting of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride with the following requirements. Fabric shall have the minimum strength values in the weakest principal direction. Nonwoven fabric may be needle punched, heat bonded, resin bonded, or combination thereof.

VALUE MINIMUM REQUIREMENTS (1)

Test	Method	Silty Soils (4)	Sandy Soils (5)
Grab Tensile-strength	ASTM D-1682(2)	100	100
Mullen Burst strength (psi)	ASTM D-3786	200	200
Equivalent Opening Size U.S. Standard sieve	CW-02215-77 Corps of Engineers	50-140	20-50
Water Flow Rate (gal/min/ft.^{2} at 50 MM Constant head	ASTM D-4491(3)	10	10
Ultra Violet Radiation Stability (percent)	ASTM D-4355	90	90

(1) All numerical values represent minimum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table.)
(2) ASTM D-1682 Grab Test, Method 16, using a 4-inch by 8-inch sample, 3-inch gauge length clamped in 1-inch by 2-inch long grip, tested at a strain rate of 12-inch/min.
(3) Water Flow Rate in gal/min/ft shall be determined by multiplying Permittivity in sec. as determined by ASTM D-4491 by a conversion factor of 74.
(4) Silty Soil: More than 15% by weight passing No. 200 sieve.
(5) Sandy Soil: Less than 15% by weight passing No. 200 sieve.

C. Furnish geotextile fabric in a wrapping which will protect the fabric from ultraviolet radiation and from abrasion because of shipping and handling. Keep geotextile dry until installed.

D. Provide posts, stakes, and wire reinforcement per Ky BMP standards.

2.03 GEOTEXTILE FABRIC–TYPE R

A. For subgrade reinforcement under riprap: Either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinlidene chloride. Fabric shall have

the minimum strength values in the weakest principle direction. Nonwoven fabric may be needle punched, heat bonded, resin bonded, or combinations thereof.

B. Insect, rodent, mildew, and rot resistant.

C. Furnish in a wrapping which will protect fabric from ultraviolet radiation and from abrasion because of shipping and hauling. Keep geotextile dry until installed.

D. Clearly mark fabric rolls showing fabric type.

E. If sewn seams are used, furnish a field-sewn seam sample produced from the geotextile fabric and thread and with the equipment to be used on the project prior to installation.

F. Comply with the following physical properties:

Test	Method	Value
Grab Tensile Strength (lbs) Puncture Strength (lbs)	ASTM D-4632 Modified	200 min.
using 5/16-inch Flat-tipped Rod	ASTM D-3787	80 min.
Mullen Burst (lbs/in^2)	ASTM D-3786	250 min.
Elongation at Required Strength (percent)	ASTM D-4632	20 min.
Equivalent Opening Size (U.S. Standard Sieve)	ASTM D-4751	30-140
Water Flow Rate (gal/min/ft^2) at 50 mm Constant Head	ASTM D-4491	10 min.

2.04 STRAW BALE BARRIERS

A. Provide per Kentucky BMP standards.

PART 3–EXECUTION

3.01 GENERAL

A. Install devices before construction activities begin.

B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).

C. Unless noted on Drawings, do not remove trees and surface vegetation.

D. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable.

3.02 EROSION MAT INSTALLATION

A. Place erosion mat immediately after seeding or sodding operations have been completed. Before mat placement, remove all material or clods over 1 1/2 inches in diameter and all

organic material or other foreign material which interfere with the mat bearing completely on the soil or sod.

B. Any small stones or clods which prevent contact of the mats with the soil shall be pressed in the soil with a small lawn-type roller or by other effective means. The mat shall have its lateral edge so impressed in the soil as to permit runoff water to flow over it.

C. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly, smoothly, in a natural position without stretching and with all parts bearing on soil and place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with the upgrade section on top.

D. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the embedded fabric or blanket.

E. Anchor mats in place with vertically driven staples driven until their tops are flush with the soil. Space staples at 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.

F. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.

G. Dispose of surplus excavated materials, and all stones, clods or other foreign material removed in the preparation of the seeded soil or sodded surface before placing mat.

H. Following mat placement, uniformly apply water to the area to moisten seedbed to 2-inch depth and in a manner to avoid erosion.

I. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires or other causes until work acceptance.

3.03 GEOTEXTILE FABRIC–TYPE R

A. Before placing fabric, grade area smooth and remove stones, organic matter, or other foreign material which would interfere with fabric being completely in contact with soil.

B. Place fabric loosely and lay parallel to direction of water movement. Pinning or stapling is acceptable to hold geotextile in place. Overlap or sew together separate pieces of fabric. Overlap joints a minimum 24 inches in the flow direction. After placement, do not expose fabric more than 48 hours before covering.

C. Cover damaged areas with a patch of fabric using a 3-foot overlap in all directions.

3.04 SILT FENCE INSTALLATION

A. Erect silt fence before starting construction operations which might cause sedimentation or siltation at site of proposed silt fence.

B. Construct silt fence in an arc or horseshoe shape with ends pointing up slope. Construct silt fence to the dimensions and details shown on Drawings. Remove silt fences after slopes and ditches have been stabilized and turf developed to the extent that future erosion is unlikely. Dispose of materials remaining after removal.

C. Inspect all silt fences immediately after each rainfall and at least daily. Correct deficiencies immediately. Where construction activity changes the earth contour and drainage runoff, make a daily review to ensure that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences.

D. Remove and dispose of sediment deposits. Sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade and the area topsoiled, fertilized, and seeded as required.

3.05 STRAW BALE BARRIERS

A. Provide as shown on the Drawings and as necessary on ditch lines and other drainageways to minimize construction sediment laden runoff to downstream ditches and channels and into streams.

B. Inspect all barriers immediately after each rainfall and at least daily. Correct deficiencies immediately. Where construction activity changes the earth contour and drainage runoff, make a daily review to ensure that barriers are properly located for effectiveness. Where deficiencies exist, install additional straw bales.

C. Remove and dispose of sediment deposits. Sediment deposits remaining in place after the barrier is no longer required shall be dressed to conform with the existing grade and the area topsoiled, fertilized, and seeded as required.

END OF SECTION

SECTION 02275

RIPRAP

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Furnishing and placing riprap.

B. Payment: Riprap shall be included in the unit price bid.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications. Unless specifically stated otherwise, the Measurement and Payment sections of the Standard Specifications shall not apply. Measurement and payment will be made in accordance with terms of the Contract Documents.

PART 2–PRODUCTS

2.01 MATERIALS

A. Stone for riprap shall be durable quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks, or other structural defects.

B. Stone for riprap shall be in accordance with Standard Specifications, Section 805.

C. Geotextile shall conform to Section 02270–Slope Protection and Erosion Control.

PART 3–EXECUTION

3.01 PREPARATION

A. The bed for the riprap shall be properly trimmed and shaped before geotextile and stone is placed. Bed shall be minimum 6 inches thick.

B. Geotextile shall be placed below riprap.

3.02 INSTALLATION

A. Riprap shall be provided in areas as designated on the Drawings.

B. Stone placed above the water line shall be placed by hand. It shall be laid with close, broken joints and shall be firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with ends in contact.

C. The rip rap is to be installed on all slopes in side holding pond.

D. The riprap shall be thoroughly compacted as construction progresses, and the finished surface shall present an even, tight surface.

E. The large stone shall be placed in the lower courses. Interstices between stones shall be chinked with spalls firmly rammed into place.

F. Unless otherwise shown or specified, riprap shall be at least 18 inches in thickness, measured perpendicular to the slope.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVING

PART 1–GENERAL

1.01 SUMMARY

A. Work includes asphaltic concrete paving, tack coat, and casting adjustments.

B. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall repair all roads, shoulders, and paved areas damaged during the project in accordance with this section. Gravel shoulders, gravel roads, and parking areas shall be repaired in accordance with Section 02231 - Aggregate Base Course.

C. Payment: Payment for asphaltic concrete paving shall be considered incidental to the project and included in the prices Bid.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Kentucky Department of Transportation Construction and Material Specifications.

1.03 DEFINITIONS

A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01300 - Submittals.

PART 2–PRODUCTS

2.01 ASPHALTIC CONCRETE PAVEMENT

A. Asphaltic material for binder course and surface course shall meet the requirements for Class I mixtures as set forth in Section 401 of the Standard Specifications. The mixtures shall have been approved recently by the Kentucky Transportation Cabinet and used recently on a state job.

B. Aggregate shall conform to the requirements of the Standard Specifications.

C. Materials for prime coat shall conform to the requirements of the Standard Specifications and shall be Primer L.

D. Material for tack coat shall conform to the requirements of Section 806 of the Standard Specifications.

E. Replacement of existing paved surfaces shall be a minimum of 4 1/2 inches in thickness or existing thickness, whichever is greater. Binder course shall be 3 inches minimum. Surface course shall be 1 1/2 inches minimum.

PART 3–EXECUTION

3.01 ALLOWABLE REMOVAL OF PAVEMENT

A. CONTRACTOR shall remove bituminous pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.

B. All bituminous pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

3.02 TACK COAT

A. All work shall be in accordance with the Standard Specifications.

B. If asphaltic surface course is applied to an existing street or is not applied the same day as binder course, the existing street or binder surface shall be tack coated prior to surface paving. Prior to placement of tack coat the streets shall be thoroughly cleaned and broomed. Tack coat shall be applied at a rate of 0.10 gallons per square yard immediately prior to placement of asphaltic surface course.

C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.

3.03 JOINTS

A. Joints between old and new pavements or between successive days' work shall be constructed and treated as to insure thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with tack coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.

B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the surface course shall at no time be placed immediately over similar joints in the binder course beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the binder course and the location of similar joints in the surface course above.

C. All costs for furnishing and applying tack coat to butt joints as specified above shall be considered incidental.

3.04 FINISHING ROADWAY

A. The finished base course shall be fine-graded in preparation for asphaltic concrete paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand trimmed and compacted with a vibratory plate compactor.

B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing binder course to receive surface course shall be removed. Asphaltic ramps shall be installed on all manholes and at all butt joints in areas to receive binder course only.

C. Finishing roadway shall be considered incidental to asphaltic paving.

3.05 TESTING ASPHALTIC CONCRETE

A. ENGINEER may require samples of asphaltic concrete for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.

3.06 ASPHALTIC PAVING

A. Asphaltic paving work shall include the construction of plant mixed asphaltic concrete pavement in the areas shown on the Drawings. All work shall be performed in accordance with the Standard Specifications.

B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.

C. The pavement structure for new roads shall be determined from the standard cross sections provided on the Drawings.

END OF SECTION

SECTION 02600

BURIED PIPING AND APPURTENANCES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All underground piping and valves of every description.
   2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
   3. Concrete reaction blocking, gaskets, restraints, and all miscellaneous equipment furnished under this section.
   4. Underground piping connections to all equipment, whether furnished under this section or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction.

B. Plumbing Code: Unless otherwise indicated, plumbing code within this section shall refer to the Kentucky State Plumbing Law, Regulations and Code.

C. Ten State Standards.

D. Kentucky Division of Water Code.

PART 2–PRODUCTS

2.01 MATERIALS

A. Materials–General: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF)-approved.

B. Size and Type:
   1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
   2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.

C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

D. Ductile Iron Piping and Fittings:
   1. Unless otherwise specified, all exterior piping shall conform to AWWA C151 with wall thickness provided in accordance with AWWA C150 for the depth of cover shown on the Drawings using a minimum rated working pressure above 350 psi and Laying Condition 4; minimum Special Class 52, unless otherwise shown or specified. The words "ductile iron," weight, and class of pipe shall be plainly marked on each piece of exterior pipe.
   2. Except where shown, exterior pipe joints shall be mechanical joint or push-on joint. All mechanical and push-on joints shall be bonded with cable bond conductors or electrobond conductivity strips.
   3. Exterior joints and gaskets shall conform to AWWA C110 and C111.
   4. Bolts on exterior joints shall be high-strength low-alloy steel (Corten or equal) conforming to AWWA C111. Certificate to that effect shall be provided.
   5. Except where shown otherwise, exterior fittings shall be mechanical joint or push-on joint. Exterior fittings and gaskets shall comply with AWWA C110, Ductile Iron Fittings, or C153 Ductile Iron Compact Fittings, and C111, as applicable, with a minimum rated working pressure above 350 psi.
   6. Exterior and/or buried pipe and fittings shall be cement-mortar lined and asphaltic coated inside and asphaltic coated outside. Cement-mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
   7. Ductile iron push-on joint restraint shall be American Flex-Ring or Lok-Ring megalugs, US Pipe TR Flex, Ebaa Iron 1100 HD or 1700, or equal.
   8. Ductile iron mechanical joint restraint shall be Ebaa Iron 1100 or 1100SD, or equal.
   9. Ductile iron push-on joint restraint using gaskets shall be American Fast Grip, US Pipe Field Lok, or equal.

E. Copper Piping: All buried copper piping shall be provided as specified in Section 15040–Piping and Accessories.

F. Valves: Valves for underground service are specified in Section 15040–Piping and Accessories.

G. Manholes:
   1. Manholes shall be precast reinforced concrete manholes, conforming to ASTM C-478 and Drawing 01-975-43A, except as specified herein. Manhole diameters shall be as shown.
   2. Solid precast manhole bottoms shall be provided except where shown on the Drawings. Joints between manhole sections shall be circular rubber O-ring gaskets or mastic compound.
   3. Gaskets shall conform to ASTM C-443.
   4. Manhole steps shall be MA Industries PS 1, -PF, or equal.
   5. Manhole castings shall be Neenah R-1550, Type B, open pick hole, nonrocking lid design, or equal.

H. Fire Hydrant:
   1. Fire hydrant shall be Waterous W-67 Pacer with 5-inch barrel, compression shutoff two 2 1/2-inch and one 4 1/2-inch nozzle with three chains and Waterous No. 2 nut.
   2. Hydrant to be built for 3-foot bury and be painted blue.
   3. About 1/2 cubic yard of coarse gravel shall be placed from the bottom of the trench up the hydrant barrel. Brace with solid concrete block not concrete.
   4. Provide restrained joint system from auxiliary valve in road box back to tee.
   5. Connect hydrant to auxiliary valve with 2-foot length of pipe. Auxiliary valve shall be gate valve with cast iron road box as specified in Division 15.

PART 3--EXECUTION

3.01 INSTALLATION

A. Size, Type, and Joining: All materials shall conform to the size and type shown on the Drawings or called for in the specifications. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.

B. Installation Standards:
   1. Except where noted or specified, all underground water main piping shall be laid in accordance with AWWA C600 with all sewer clearances and separations from water main in accordance with Kentucky Division of Water requirements.
   2. Plumbing system shall be installed in accordance with applicable portions of the Kentucky State Plumbing Code. Where requirements conflict, the stricter standard shall apply.
   3. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided as required.

C. General Excavation:
   1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract, unless otherwise noted.
   2. Work shall conform to other sections of Division 2 except where modified by this section.
   3. The width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines.
   4. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used as necessary.
   5. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense.
   6. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill and rock excavation, the removal of pavement, and all incidental work thereto. All above work shall be included in the price Bid.
   7. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown all pipe, manholes, and other work as required to complete the project as shown.
   8. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for

construction according to grades shown or specified shall be removed and replaced with material and placing methods as specified in Section 02222-Excavating, Backfilling and Compaction.

9. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable.
10. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work.
11. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service.
12. The present underground services shown on the Drawings are located in accordance with available data.
13. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
14. Any service connections encountered which are to be removed shall be cut off at the limits of the excavation and capped in accordance with the requirements of owners of such connections.
15. Excavated material that is unsuitable or not required for filling shall be wasted.
16. Materials to be used for fill and suitable for this purpose shall be deposited where required, except that no fill shall be placed where trenches for sewers, water lines or other services will be located until after the trench work is completed.
17. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.

D. Laying Pipe:
1. CONTRACTOR shall excavate and lay all pipe to the line shown on the Drawings with bell ends uphill.
2. Water lines shall have a minimum of 3 feet of cover, unless noted otherwise.
3. Unless shown otherwise, under floor piping shall clear floor slabs or footings by a minimum of 6 inches.
4. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used.
5. Pipe must be kept clean of mortar, cement, clay, sand, or other material.
6. Trenches shall be kept water-free and dry during bedding, laying, and jointing.
7. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.
8. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.

E. Restraint Based on Flexible Restrained Joints, not Thrust Blocking:
1. Except where noted or indicated, all bends, caps, plugs, tees, and other fittings shall be restrained with flexible restrained joints.
2. Restraining joints as specified for type of pipe or fitting provided.
3. CONTRACTOR shall restrain the entire length of piping and fittings on the discharge side of the booster station and at least 15 feet on each side of the fittings and on the suction side of the booster station.

F. Bedding:

1. All underground pipe, except copper, perforated pipe, and polyethylene-encased pipe, shall be bedded in compacted granular material. Native material may be utilized when specified.
2. Ductile iron piping shall be placed using Class "C" Bedding Details as shown on Drawing No. 01-975-43A.
3. CONTRACTOR shall perform all necessary excavation and shall furnish all required materials to provide bedding material. Bedding material shall conform to the gradation requirements of ASTM C-33.
4. For Kentucky spec, bedding material shall be #9 crushed stone as defined by the State of Kentucky Transportation Cabinet Department of Highways Standard Specifications for Road and Bridge Construction. Bedding material shall be hard, tough, and durable and shall meet the following gradation requirements.

	Crushed Stone Aggregate	Crushed Stone Chips	Crushed Gravel Aggregate	Bedding Sand
1-inch	100	---	100	---
3/4-inch	90 to 100	---	90 to 100	---
1/2-inch	---	100	---	---
3/8-inch	20 to 55	90 to 100	20 to 55	100
No. 4	0 to 10	---	0 to 10	95 to 100
No. 8	0 to 5	0 to 15	0 to 5	80 to 100
No. 30	---	0 to 5	---	25 to 60
No. 100	---	---	---	5 to 20
Passing No. 200	---	---	---	2 to 10

5. Native material may be used for ductile iron piping if it contains no stones larger than 3/4- inch.
6. Immediately prior to placing the pipe, bedding shall be shaped by hand to fit the entire bottom quadrant of the pipe between bell holes.
7. Bell holes shall be large enough to permit proper making of the joint but not larger than necessary to make the joint.
8. All adjustments to line and grade must be done by scraping away or filling in bedding under the body of the pipe. Bedding must be tamped into place.
9. If necessary to obtain uniform contact of the pipe with the bedding, a template shall be used.

G. Cover Material:

1. Material which is to be placed from the bedding material around and to 1 foot above the top of all pipe shall be termed cover material.
2. Except for copper piping, cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination.
3. No. 57 or No. 9 crushed stone will be considered generally acceptable for cover material.
4. No stones larger than 3/4-inch in their greatest dimension shall be allowed in the cover material.
5. Native materials may be used if they conform to the above specifications.
6. Material for copper piping shall be sand.

7. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously.
8. This cover material shall be placed by hand in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers.
9. If bedding material, except sand, conforming to any of the above three gradations under "Bedding" is used as cover material, it need not be tamped.
10. Sand cover material must be tamped.
11. Unless sand backfill is required, the remaining 6 inches to make up the required 1 foot of cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4-inch.
12. Compaction shall be equivalent to that described under "Filling and Backfilling" in these specifications.

H. Backfill:
1. No trenches shall be backfilled until the line has been observed by ENGINEER and permission given to close the trench.
2. Except as otherwise specified, all backfill above 1 foot above the pipe shall be granular material specified in Section 02222–Excavation, Fill, Backfill and Grading. Compaction shall be as specified herein.

3.02 REPAIR/RESTORATION

A. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced, including all site improvements, landscaping, and/or paving material as existed prior to construction.

3.03 FIELD QUALITY CONTROL

A. Site Tests:
1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
2. All piping shall be subject to test before being covered with base course or pavement. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
3. All piping and appurtenances shall be flushed or cleaned after installation prior to testing.
4. When test medium for piping is water, all air shall be removed from piping by flushing and/or installation of corporations at high points in system. Presence or absence of air will be determined during pressurization of the piping system.
5. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge, and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing. Note, when pressure testing against existing valves or piping, CONTRACTOR shall assume these items will fail and provide temporary plugging or valving as required.
6. Pressure Tests: The test pressure in all nongravity lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.

7. Leakage allowance shall be not more than 0.002 gallon per hour per inch diameter per 100 feet of buried pipe for compression or solder joint pipe. Buried mechanical and push-on joint pipe shall meet the leakage specifications of AWWA C600.

3.04 CLEANING AND DISINFECTION

A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line. Water main shall be disinfected according to AWWA C651.

B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Bid. Copies of test results shall be submitted to OWNER and ENGINEER.

C. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.

D. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction.

E. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 02831

CHAIN LINK FENCE

PART 1–GENERAL

1.01 SUMMARY

A. Work includes providing all chain link fencing and gates, complete, as shown on the Drawings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A121–Zinc-Coated (Galvanized) Steel Barbed Wire.

B. ASTM A123–Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

D. ASTM A181–Forgings, Carbon Steel for General Purpose Piping.

E. ASTM A392–Zinc-Coated Steel Chain-Link Fence Fabric.

F. ASTM A428–Weight of Coating on Aluminum-Coated Iron or Steel Articles.

G. ASTM A446–Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

H. ASTM A491–Aluminum-Coated Steel Chain Link Fence Fabric.

I. ASTM A569–Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.

J. ASTM A585–Aluminum-Coated Steel Barbed Wire.

K. ASTM A641–Zinc-Coated (Galvanized) Carbon Steel Wire.

L. ASTM F567–Installation of Chain-Link Fence.

M. ASTM F669–Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence.

N. ASTM F1083–Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

O. ASTM F1234–Protective Coatings on Steel Framework for Fences.

P. Chain Link Fence Manufacturers' Institute (CLFMI)–Product Manual.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The chain link fence shall be USS Cyclone, Century Fence, or equal.

2.02 POSTS, RAILS, AND BRACES

A. Construction:
1. All posts and rails shall be either Type 1 Schedule 40 pipe with 1.8 ounce per square foot zinc coating conforming to ASTM Specification F-1083; or Type II pipe manufactured from steel conforming to ASTM A-569 Cold-Formed, Electric Welded and Triple Coated with ounce ±0.1 ounce zinc per square foot, 30° 15 micrograms chromate, 0.5° 0.2 mils clear cross-linked polyurethane acrylic exterior coating.
2. Internal surface shall be given corrosion protection by 0.2-inch rich based organic coating with 87% minimum zinc powder loading, with the capacity of withstanding 300 hours when subjected to Salt Spray Test ASTM B-117 with 5% maximum red rust.
3. Intermediate posts shall be 2.5-inch O.D., round column Type I 3.65 pounds per foot, Type II 3.12 pounds per foot, or 2.25-inch by 1.7-inch 11 gauge "C" Section.
4. All posts shall be braced with the same material as top rail and trussed to line posts with 3/8-inch-diameter rods and tightened. One brace assembly shall be provided with each end or gate post and two assemblies with each corner or pull post.
5. All end, corner, and pull posts shall be 3-inch as shown on detail O.D. standard weight pipe, Type 1 5.79 pounds per linear foot, or Type II 4.64 pounds per foot.
6. Pipe posts shall have tops which exclude moisture.
7. Rails shall be 1 1/5-inch by 1 1/4-inch 14 gauge rolled formed section or 1 5/8-inch O.D. Type 1 2.27 pound per foot, or Type II 1.84 pounds per foot pipe.

2.03 FABRIC

A. Construction:
1. Fabric to be No. 9 gauge steel wire or aluminum-coated steel wire woven in a 2-inch mesh; top selvage to have barbed finish, bottom selvage to be knuckled.
2. Galvanized coating of wire surface shall be in accordance with A392-68T. Zinc coating shall be Class 2, minimum of 2 oz. of zinc per square foot of wire surface. The weight of coating shall be determined by the strip test, ASTM A-428. Aluminum coating shall conform to ASTM A491 and shall be 0.40 oz/sq ft minimum.
3. Fabric height shall be 6 feet.
4. Fasteners shall be galvanized steel wire clips and tie wires in accordance with ASTM A-641 Class III or aluminum coat in conformance with fence fabric specifications.

2.04 GATES

A. General:
1. All drive gates shall be swing-type.
2. All man gates shall be swing-type.
3. Gate widths shall be as shown on Drawings.
4. Top of gate fabric shall line up with adjacent fence fabric; gate fabric shall be the same as for fence.

B. Construction:
   1. Gate construction shall be sized in accordance with chain link fence manufacturer's Institute Product Manual and shall be properly braced and trussed.
   2. Gates shall have positive-type latching devices with provision for padlocking. OWNER will provide padlock. Latching device shall be operable from either side of gate.
   3. Hinges shall be galvanized pressed steel or malleable iron to suit gate size, nonlift-off type, offset to permit 180± gate opening.
   4. Provide keeper for each gate leaf which automatically engages the gate when swung open and holds gate in open position.

2.05 ACCESSORIES

A. General: All accessories, except tie wires and barbed wire, shall be galvanized to comply with ASTM A 153.

B. Barbed Wire:
   1. Provide 3 strands of barbed wire at top of fence.
   2. Barbed wire shall be 2-strand, 12 1/2-gauge wire with 14-gauge, 4-point round barbs spaced approximately 5-inch o.c.
   3. Finish shall be galvanized to meet ASTM A 121, Class 3 or aluminized to meet ASTM A 585, Class 2.

C. Barbed Wire Supporting Arms:
   1. Arms shall be heavy pressed steel complete with provisions for anchorage to tubular end, corner, and pull posts attaching 3 rows of barbed wire to each arm.
   2. Arms not required on roll-formed terminal posts.
   3. Single arms shall be integral with a post top weather cap.
   4. Intermediate arms shall have hole for passage of top rail.
   5. Arms shall be capable of withstanding, without failure, 250 pounds of downward pull at outermost end of arm.

D. Post Tops:
   1. Material shall be pressed steel or malleable iron.
   2. Top shall be weathertight.
   3. Top shall permit passage of top rail.

E. Stretcher Bars:
   1. Stretcher bars required for tubular end, corner, pull, or gate posts.
   2. Bars shall be one-piece lengths equal to full height of fabric with minimum cross section of 3/16-inch by 3/4-inch.
   3. Provide one stretcher bar for each gate and end post and two stretcher bars for each corner and pull post.

F. Stretcher Bar Bands:
   1. Material shall be heavy pressed steel.
   2. Spacing shall be 15 inches maximum o.c. to secure stretcher bar to tubular end, corner, pull, and gate post.

G. Tension Wire: 7 gauge, zinc-coated steel wire.

2.06 CONCRETE

A. Concrete shall be Type A or A-FA as specified in Section 03300–Cast-in-Place Concrete.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories, and gates in accordance with ASTM F567 and manufacturer's instructions.

B. Place fabric on outside of posts and rails.

C. Set posts plumb in concrete footings with top of footing 6 inches below finish grade. Concrete bases shall be crowned at the post and have a smooth troweled finish. Post footings shall be minimum 10 inches in diameter and shall extend 36 inches minimum below finish grade.

D. Posts shall be provided at 10 feet on center maximum.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Provide brace rail one bay from end and gate posts.

F. Provide top rail through line post tops and splice with sleeves.

G. Provide center bottom brace rail on corner gate leaves.

H. Do not stretch fabric until concrete foundation has cured 14 days.

I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

J. Position bottom of fabric 2 inches above finished grade.

K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

M. Provide bottom tension wire stretched taut between terminal posts.

N. Provide support arms sloped outward and attach barbed wire; tension and secure.

O. Install gate with fabric and barbed wire overhang to match fence. Install three hinges per leaf, latch, catches, and keepers.

3.02 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Components shall not infringe adjacent property lines.

END OF SECTION

SECTION 02930

RESTORATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Placement of topsoil.
   2. Fertilizing.
   3. Seeding.
   4. Mulching.
   5. Maintenance.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Payment: Payment for restoration shall be included in the price bid. Costs for topsoiling, seeding, fertilizer, mulching, and maintenance of restored areas shall be included. One percent of the total Contract price shall be retained following project completion until a uniform 2-inch growth of vegetation is established over all restored areas. CONTRACTOR shall be responsible to make its own computations for area restoration.

1.02 REFERENCES

A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Kentucky Transportation Cabinet, Department of Highways, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications. Unless specifically stated otherwise, the Measurement and Payment sections of the Standard Specifications shall not apply. Measurement and payment will be made in accordance with terms of the Contract Documents.

B. FS O-F-241 – Fertilizers, Mixed, Commercial.

1.03 QUALITY ASSURANCE

A. All work shall be in accordance with Standard Specifications, unless noted otherwise.

B. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

PART 2–PRODUCTS

2.01 TOPSOIL

A. Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

B. Topsoil from the site may be used if it meets the above requirements.

2.02 SEED

A. Seed mixture No. II per Standard Specifications.

B. Weed content shall not exceed requirements of the Standard Specifications.

2.03 FERTILIZER

A. Fertilizer shall be FS O-F-241, Type I, Grade A; recommended for grass with 50% of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 10%, phosphoric acid 10%, soluble potash 10%. Submit composition deviations to suit site conditions for ENGINEER's approval.

2.04 MISCELLANEOUS

A. Mulching material and asphalt tackifier shall conform to Section 827 of the Standard Specifications. Hay or chopped cornstalks are not acceptable as mulch.

B. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

C. Erosion fabric shall be jute matting, open weave.

PART 3–EXECUTION

3.01 DELIVERY, STORAGE AND PROTECTION

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. All areas disturbed construction shall be restored. All slopes shall be seeded to the slope intercept. Borrow sites and disposal sites will not require seeding, but they shall be graded smooth.

3.02 TOPSOIL

A. Placing topsoil shall be in accordance with Section 212 of the Standard Specifications. Topsoil shall be placed to a uniform depth of 6 inches in place. Topsoil placement shall be incidental to seed, fertilizer, and mulching.

3.03 SEEDING

A. Seeding shall be performed in accordance with Section 212 of the Standard Specifications.

B. Seed shall be applied at the rates specified in Section 212 of the Standard Specifications.

3.04 FERTILIZER

A. Fertilizer shall be applied per Section 212 of the Standard Specifications.

3.05 MULCHING

A. All areas receiving seed shall be mulched.

B. Straw mulching shall be performed in accordance with Section 212 of the Standard Specifications.

END OF SECTION

SECTION 02950

TREES, PLANTS, STONE MULCH, AND EDGING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Trees and plants.
   2. Hardwood mulch.
   3. Plastic and aluminum edging.
   4. Maintenance.
   5. Tree Pruning.

1.02 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years experience. Plant materials shall be free of disease and hazardous insects.

B. Installer Qualifications: Company specializing in installing and planting the plants with three years experience.

C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

1.03 WARRANTY

A. All plant material is to be fully guaranteed for a period of one year from the date of final completion. Only those plants that are alive and normally healthy for the first year will be accepted. Unaccepted material shall be removed and replaced by CONTRACTOR at no cost to OWNER during the next suitable growing season.

B. Replacement plants shall be the same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

PART 2–PRODUCTS

2.01 TREES AND PLANTS

A. Trees and Plants: Species and size identifiable in plant schedule grown in climatic conditions similar to those in locality of the work.

2.02 MULCH MATERIALS

A. Mulching Material: Organic hardwood mulch free of growth or germination-inhibiting ingredients.

2.03 ACCESSORIES

A. Wrapping Materials: Burlap or other commercial grade tree wrap.

B. Stakes: Softwood lumber, pointed end or mild steel angle, galvanized, pointed end.

C. Cable, Wire, Eye Bolts: Noncorrosive and of sufficient strength to withstand wind pressure and resulting movement of plant life.

D. Tree Protectors: Rubber sleeves over cable to protect tree stems, trunks, and branches.

E. Membrane: 20 mil thick, water permeable polyolefin fabric.

F. Edging: Black Diamond Bed Divider by Valley View Specialty Co.; Ezy-Lok Edging by Ryerson Steel Co., or equal. Aluminum edging shall be 1/8-inch by 4 inches. Plastic edging shall have a minimum 5-inch side wall and 1-inch-diameter head. Edging shall have a v-lip configuration for added stiffness and anchor holding power.

PART 3–EXECUTION

3.01 PLANTING

A. Plant pits shall be excavated with vertical sides. These holes shall be at least 18 to 24 inches greater in diameter than the plant ball, container, or root system and at least 12 inches deeper than the bottom of the ball, container, or root system when the plant is at its proper grade. Set plants vertical.

B. Place topsoil in holes around roots or balls mixed with fertilizer and peat moss or compost. Topsoil around roots shall be compacted and watered. After plant pit is backfilled, shallow basin shall be formed with ridge of soil to facilitate watering.

C. Place plants where indicated on the drawings. Position plants for best appearance.

D. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

E. Remove nonbiodegradable root containers.

3.02 TREE REMOVAL AND REPLACEMENT

A. Trees marked for removal within street and road rights-of-way and in easements shall be removed by CONTRACTOR and properly disposed. Trees within street and road rights-of-way marked for removal need not be replaced unless specifically noted otherwise on drawing. CONTRACTOR shall replace all other removed and damaged trees and shrubs with new stock at its expense. New trees shall be located as requested by OWNER or ENGINEER.

B. Trees shall be replaced as follows. Diameters shall be measured 4 feet above the ground.

Deciduous Trees

Up to 1-1/2 inches	Like size and type
Greater than 1-1/2 inches	Min. 1-1/2 inch of like type

Coniferous Trees

Up to 6 feet tall	Like size and type
Greater than 6 feet tall	Min. 6-foot tree of like type

C. All bushes and shrubs removed during construction shall also be restored to their original position and condition. If the bush or shrub is damaged or dies after restoring, CONTRACTOR shall replace it with one of same kind and size up to a height of 4 feet. Bushes and shrubs beyond this height shall be replaced by one four feet.

D. It is intended that as many trees as possible be saved during construction. No trees, except those so designated, shall be removed without prior approval. CONTRACTOR shall conduct the work to protect all trees to remain. CONTRACTOR shall provide suitable barricades of lumber and wire netting to wrap around all tree trunks within the construction area to protect trees from damage by its equipment.

E. Trees which are damaged during construction shall be repaired. CONTRACTOR shall retain the services of a professional nurseryman who is a member of the National Arborist Association to direct them on the proper repair of damaged trees. Damaged limbs and roots shall be pruned or dressed according to recommendations of the nurseryman. Backfill shall be replaced as soon as possible to reduce exposure of roots to air. Scarfed areas on trees shall be suitably dressed. Compaction of root areas under the drip line of the tree is to be avoided whenever possible.

F. When removing trees, special care shall be taken so as not to damage surrounding private property. Tree removal method shall be reviewed by ENGINEER and approved by OWNER. Costs for tree removal or replacement and construction around trees shall be included in the price bid for the work. Tree removal included in cleaning and grubbing is Section 02110-Site Clearing and Stripping.

G. CONTRACTOR shall relocate and bore and jack under or by such trees as desired to minimize construction damage. Cost for such construction shall be included in the price bid for the work.

3.03 INSTALLATION OF ACCESSORIES

A. Place edging around planting areas where shown on the drawings. Install edging using stakes at approximately 4 feet on center.

B. Place stone mulch over membrane to 4-inch depth where indicated on drawings.

C. Wrap deciduous shade and flowering tree trunks and place tree protectors.

3.04 PLANT SUPPORT

A. Brace plants vertically with plant protector-wrapped guy wires and stakes to the following:

Tree Caliper	Tree Support Method
1-inch	1 stake with one tie
1 to 2 inches	2 stakes with two ties
2 to 4 inches	3 guy wires
Over 4 inches	4 guy wires

3.05 TREE PRUNING

A. Each tree and shrub shall be pruned in accordance with good horticulture practice to preserve natural character of plant and to facilitate growth.

3.06 MULCH

A. All trees and plants shall be mulched with organic hardwood mulch free from deleterious materials, weeds, stones, and sticks. Mulch site shall be maximum 3 inches. Place membrane on areas to receive mulch. Mulch shall be placed to a depth of not less than 4 inches.

3.07 MAINTENANCE

A. Maintain plant life for three months after date of substantial completion.

B. Neatly trim plants where necessary.

C. Immediately remove clippings after trimming.

D. Water to prevent soil from drying out.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

F. Apply pesticides in accordance with manufacturer's instructions.

3.08 SCHEDULE - PLANT LIST

A. See drawings for schedule.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Forms for cast-in-place concrete.
   2. Form accessories.
   3. Openings for other work.
   4. Form stripping.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for "Forming" in the blank space provided in the Bid to apply in the event of any deductions from or additions to the work. The unit prices shall include all elements of work specified in this section.

1.02 REFERENCES

A. ACI 301–Structural Concrete for Buildings.

B. ACI 318–Building Code Requirements for Reinforced Concrete.

C. ACI 347–Recommended Practice for Concrete Formwork.

D. PS1–Construction and Industrial Plywood.

1.03 DESIGN

A. All formwork shall comply with ACI 347 and ACI 301.

B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.

B. Submit geometry of forms for circular structures.

PART 2–PRODUCTS

2.01 FORMS

A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.

B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

2.02 FORM TIES–NONREMOVABLE

A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.

B. All wall ties used in the placement of structures which have water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.

C. The use of wood spacers and wire ties will not be approved.

2.03 FORM TIES–REMOVABLE

A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.

B. Tie holes shall be plugged with a neoprene plug, Dayton Superior, Inc., Sure-Plug, or equal.

C. Cementitious waterproofing for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal.

2.04 FORM COATINGS

A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2.05 CHAMFER STRIPS

A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

2.06 KEYWAYS

A. Keyways shall be formed with wood inserts.

PART 3–EXECUTION

3.01 CONSTRUCTION

A. Forms shall conform to the shape, line, grade, and dimensions as shown on the Drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape and insure safety to workmen and passersby. Spacing of ties shall be recommended by the tie manufacturer.

B. Formwork shall be constructed to meet the tolerances and intentions specified below for the indicated applications:
   1. Flat surfaces shall be formed in accordance with tolerances indicated in ACI 347 for buildings.
   2. Curved surfaces shall also meet ACI 347 for buildings. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8-inch from a circle through pan edges will not be allowed.
   3. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
   4. Variation from plumb shall not exceed 1/4-inch in 10 feet, and variation in linear lines shall not exceed 1/2-inch in 20 feet. These and other tolerance specified in ACI-347 shall be considered a part of this specification.

C. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

D. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.

E. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.

F. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.

G. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to assure ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.

H. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.

I. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to the approval of ENGINEER.

3.02 FORM REMOVAL

A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.

B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete and will ensure complete safety of the structure.

C. Forms shall not be removed before the expiration of the minimum times as stated below unless specifically authorized by ENGINEER. These times may be increased by ENGINEER.
   1. Wall and vertical faces: 24 hours
   2. Columns: 24 hours
   3. Beams and slabs: 14 days

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1--GENERAL

1.01 SUMMARY

A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the Drawings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for "Reinforcing," including all elements of work in this section, in the blank space provided in the Bid to apply in the event of any deductions from or additions to the work. All reinforcement shown or specified shall be included in the Lump Sum Bid.

1.02 REFERENCES

A. Applicable standards listed in this section include, but are not necessarily limited to the following:
1. ACI 315–Manual of Standard Practice for Detailing Reinforced Concrete Structures.
2. ACI 318–Building Code Requirements for Reinforced Concrete.
3. ASTM A82–Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement.
4. ASTM A185–Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.
5. ASTM A615–Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
6. CRSI–Manual of Standard Practice.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300–Submittals.

B. Provide complete shop drawings of all material to be furnished and installed under this section:
1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

A. Delivery:
1. Deliver reinforcement to the job site bundled, tagged, and marked.

2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2–PRODUCTS

2.01 MATERIALS

A. Reinforcing bars shall comply with ASTM A615, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.

B. Steel wire shall comply with ASTM A82.

C. Welded wire fabric shall comply with ASTM A185.

D. Reinforcement supports including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.

E. Fibrous Reinforcing:
1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Tapex Concrete Fibres Division, or equal.
2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use on concrete secondary reinforcement.
3. Physical Characteristics:
   a. Specific Gravity: 0.91.
   b. Fiber Length: Multidesign gradation.

2.02 FABRICATION

A. General:
1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.

3. Unless otherwise shown on the Drawings, all end hook dimensions shall conform with "ACI Standard Hooks."

B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
   1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
   2. Bend or kinks not indicated on Drawings or final shop drawings.
   3. Bar with reduced cross section because of excessive rusting or other cause.

PART 3–EXECUTION

3.01 INSPECTION

A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.

B. Correct conditions detrimental to the proper and timely completion of the work.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:
   1. Comply with the specified standards for details and methods of placing reinforcement and supports.
   2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials which reduce or destroy bond with concrete.

B. Placing Reinforcement:
   1. All reinforcing shall be placed in accordance with Contract Drawings and with shop drawings stamped and approved by ENGINEER.
   2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
   3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
   4. Unless otherwise shown on the Drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
      a. Three inches of cover where the concrete is placed directly against ground.
      b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
      c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
      d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
   5. Reinforcement shall be positioned within ±3/8-inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be ±1/2-inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.

6. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly as approved by ENGINEER. Tack welding of reinforcing will not be permitted.
7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the Drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at ±4 feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3-foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4-foot 0-inch centers.
10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the Drawings and specifications.

C. Reinforcement Supports:
1. Strength and number of supports shall be sufficient to carry reinforcement.
2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.

D. Welded Wire Fabric:
1. Install welded wire fabric in as long of lengths as practicable.
2. Lap adjoining pieces at least one full mesh.

E. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
2. Splices in reinforcing shall be avoided wherever possible. Splices shall be Class B, Category 1 in accordance with ACI 318 and adjacent splices shall be staggered a minimum of 40 bar diameters unless otherwise shown.
3. Mechanical splices and threaded dowel bar inserts may be used where approved by ENGINEER. Splices shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

F. Embedded Items:
1. Allow other trades to install embedded items as necessary.
2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.

G. Minimum Reinforcing: Where reinforcing is not shown, provide a minimum of #4 at 8-inch centers each way in members 10 inches or less in thickness and #5 at 12-inch centers each way in each face in members greater than 10 inches thick.

H. Fibrous Reinforcing:
   1. Fibrous concrete reinforcing shall be used in slab-on-grade concrete where shown on Drawings and all precast concrete topping.
   2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
   3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All cast-in-place concrete as shown except as noted otherwise.
   2. PVC and bentonite waterstops, expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, grout topping, and other related items and accessories.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Supplemental Unit Price: CONTRACTOR shall fill in a unit price for "Concrete" in the blank space provided in the Bid to apply in the event of any deductions from or additions to the work. All concrete shown or specified shall be included in the Lump Sum Bid.

1.02 REFERENCES

A. ACI 211.1–Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

B. ACI 301–Structural Concrete for Buildings.

C. ACI 304–Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

D. ACI 305R–Hot Weather Concreting.

E. ACI 306R–Cold Weather Concreting.

F. ACI 308–Standard Practice for Curing Concrete.

G. ACI 309–Guide for Consolidation of Concrete.

H. ACI 318–Building Code Requirements for Reinforced Concrete.

I. ASTM C31–Making and Curing Concrete Test Specimens in the Field.

J. ASTM C33–Concrete Aggregates.

K. ASTM C39–Compressive Strength of Cylindrical Concrete Specimens.

L. ASTM C40–Organic Impurities in Fine Aggregates for Concrete.

M. ASTM C94–Ready-Mixed Concrete.

N. ASTM C143–Slump of Portland Cement Concrete.

O. ASTM C150–Portland Cement.

P. ASTM C156–Test for Water Retention by Concrete Curing Materials.

Q. ASTM C231–Air Content of Freshly Mixed Concrete by the Pressure Method.

R. ASTM C260–Air-Entraining Admixtures for Concrete.

S. ASTM C309–Liquid Membrane Forming Compounds for Curing Concrete.

T. ASTM C494–Chemical Admixtures for Concrete.

U. ASTM C618–Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

V. ASTM D994–Preformed Expansion Joint Filler for Concrete (Bituminous Type).

W. ASTM D1752–Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300–Submittals.

B. Submit the following information:
1. Gradation of fine and coarse aggregate–ASTM C33.
2. Specific gravity and dry rodded density of each aggregate.
3. Test of deleterious substances in fine and coarse aggregate–ASTM C33.
4. Design mix of each individual concrete mix to be used.
5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
7. Brand, type, principal ingredient, and amount of each admixture to be used.

C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

PART 2–PRODUCTS

2.01 CEMENT

A. All cement used shall be Portland Cement and shall conform to ASTM C150 and shall be Type I or Type III. Type III shall be used only when permitted by ENGINEER. All cement shall be the product of one reputable manufacturer and mill.

B. Cement shall be stored in a dry, weather-tight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

A. All fly ash used as an admixture in Portland cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

B. The combined amount of all deleterious substances in an aggregate shall not exceed 5 percent of the weight of the aggregate.

C. If required by ENGINEER, sodium sulfate soundness tests (ASTM Designation C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM Designation C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.

D. Fine aggregate shall be well graded from coarse to fine and shall conform to the following requirements:

	Percentage by Weight
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60
Passing No. 50 sieve	10-30
Passing No. 100 sieve	2-10

E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.

F. If required by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.

G. Coarse aggregate shall be well graded from coarse to fine, and when tested by laboratory sieves having square openings shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-inch Stone	1 1/2-inch Stone
Passing 2-inch sieve	---	100
Passing 1-1/2 inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. Proper proportions of 3/4-inch and 1 1/2 inches aggregate shall be used in members 10 inches thick and thicker. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.

I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

2.04 WATER

A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

2.05 ADMIXTURES

A. Water Reducing Admixture shall be Pozzolith 220N by BASF Admixtures, Inc., Daracem 19 by Grace or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.

B. Air-Entraining Admixture shall be equal to MB AE90 Standard by BASF Admixtures, Inc., Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.

C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

2.06 PROPORTIONING

A. The proportions of aggregate to cement shall be such as to produce a workable mixture which can be thoroughly compacted and which will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.

B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash-Pounds per Cubic Yard	
				Type C	Type F
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125
B	0.53	3,500	517	---	---
C	0.53	3,000	517	---	---
X	---	2,000	376	---	---

C. Except as otherwise indicated on the Drawings or specified, all concrete shall be Class A or Class A-FA concrete.

D. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a competent concrete engineer or competent laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.

E. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable unless otherwise stated.

F. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.

G. An air-entraining admixture shall be used in all concrete except at patches. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between four to seven percent by volume.

H. CONTRACTOR shall submit to ENGINEER compressive strength of concrete cylinder test results for the same concrete mixes proposed on a previous project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.

I. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device which can be adjusted to deliver the desired amount of water. All measuring, mixing, and proportioning equipment is subject to the approval of ENGINEER.

2.07 WATERSTOPS

A. PVC waterstops shall be as manufactured by Greenstreak, Inc., W.R. Meadows, Grace Construction Products, or equal. Provide serrated centerbulb-type, nontapered 3/8-inch minimum thickness waterstops manufactured from virgin polyvinyl chloride with no reclaimed/scrapped material or pigment whatsoever conforming to Corps of Engineers CRD-C-572. The waterstop shall have an integral fastening system consisting of hogrings or grommets. For nonexpansion joints, use Greenstreak, Inc. Profile No. 732 or equal. For expansion joints, use Greenstreak, Inc. Profile No. 735 or equal.

B. Bentonite waterstop shall be flexible strip of bentonite waterproofing compound equal to Waterstop-RX as manufactured by the Colloid Environmental Technologies Company (CETCO), Swellstop by Greenstreak, Inc., or equal. The strip shall be 1-inch by 3/4-inch for walls with a double mat of reinforcing and 3/4-inch by 3/8-inch for walls with a single mat of reinforcing.

2.08 JOINT FILLER

A. Expansion joints shall have standard 1/2-inch-thick cork expansion joint filler; W. R. Meadows or equal; meeting ASTM D1752–Type II. Exceptions to this are expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick; Grace, W.R. Meadows, or equal; meeting ASTM D994.

2.09 BONDING AGENT

A. Acceptable manufacturers include Thorobond by Harris Specialty Chemicals, Inc., Sonocrete by Sonneborn Contech Co., Sonoprep by Sonneborn Contech Co., or equal.

2.10 PATCHING ADDITIVE

A. Acceptable manufacturers include ACRYL 60 by Harris Specialty Chemicals, Inc., Sonocrete by Sonneborn Contech Co., or equal.

2.11 NONSHRINK GROUT

A. Acceptable manufacturers include Dayton Superior, Master Builders, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

2.12 CURE–SEAL–HARDENER

A. Penetrating sealer shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal.

PART 3–EXECUTION

3.01 MIXING

A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304 from an approved batching plant. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.

B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.

C. No water shall be added on the job unless authorized by ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets.

D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the job site.

E. With each load of concrete CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
   1. Date.
   2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
   3. Type of cement and admixtures, if any.
   4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
   5. Amount of concrete in load, in cubic yards.
   6. Water added at job, if any.
   7. Truck number and time dispatched.
   8. Number of mixing drum revolutions.

F. For job mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials, and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device which will positively prevent discharging the mixture until the specified mixing time has elapsed.

3.02 JOINTS

A. CONTRACTOR shall place all joints as shown on the Drawings or specified herein. If approved by ENGINEER, CONTRACTOR may, at his own expense, place construction joints in addition to and at places other than those shown on the Drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.

B. Where joints are not shown on the Drawings or specified elsewhere, CONTRACTOR shall provide joints as follows:
   1. Walls shall have vertical joints at 30 feet on center maximum but not more than 15 feet from corners or intersections and shall have horizontal joints at 15 feet on center maximum.
   2. Slabs shall have joints at 20 feet on center maximum in each direction.

C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.

D. Concrete at all joints shall have been in place at least 24 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

3.03 WATERSTOPS

A. Unless noted otherwise, PVC waterstops shall be provided at all expansion joints and at construction joints in floors and walls of structures exposed to ground or liquid on one side and occupied by personnel or nonsubmerged equipment on the other side.

B. PVC waterstops shall be made continuous by splicing. Waterstops shall be spliced using a corner, tee, or cross splice, as applicable, at intersections. Waterstops shall be mitered to maintain the continuity of the ribs and center bulb. Splices shall be made using a hot metal plate or an electric splicer and full butt weld. Direct flame will not be allowed. Sample field-splices shall be submitted to ENGINEER for approval prior to construction.

C. PVC waterstops placed in all joints shall be securely held in place by an approved method or as shown on the Drawings. PVC waterstops shall be installed and secured prior to concrete placement. PVC waterstops shall not be inserted into wet concrete. No nails will be permitted through the waterstop. Great care shall be taken when concrete is placed to insure that the waterstop remains erect and is not bent over.

D. Unless noted otherwise, bentonite waterstop shall be provided at all construction joints in liquid holding tanks and channels which are not adjacent to areas occupied by personnel and at joints between new and existing concrete. Waterstop shall be placed as shown on Drawings.

3.04 BONDING TO EXISTING CONCRETE

A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

B. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish to match existing concrete. New

concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

3.05 EMBEDDED ITEMS IN CONCRETE

A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

3.06 PLACING CONCRETE

A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.

B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.

C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.

D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the segregation or loss of materials. Chuting concrete directly into the form will not be allowed. Chuting for conveying purposes will be allowed only upon approval by ENGINEER and must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.

E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.

F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.

G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. When concreting is once started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.

H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.

I. A sufficient number of spare vibrators shall be kept in ready reserve to assure adequate vibration in case of breakdown of those in use.

J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.

K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.

L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

3.07 MOIST CURING

A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:

1. Wood forms left in place and kept wet at all times. If the forms are not going to be kept wet, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces which are to be painted, receive ceramic tile or resilient flooring, or be waterproofed unless approved by ENGINEER. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.
6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."

B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

3.08 HOT WEATHER CONCRETING

A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.

B. The temperature of the delivered concrete shall not exceed 85°F.

C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the job site.

D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.

E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.

F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

3.09 COLD WEATHER CONCRETING

A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than three successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, Standard Specification for Cold Weather Concreting, published by the American Concrete Institute, Detroit, Michigan, except as modified by the requirements of these specifications.

B. Detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been accepted.

C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.

D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.

E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R-78 shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete

shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.

F. If heating is used, the housing shall be constructed weather-tight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within two hours after concrete placement.

G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.

H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to insure compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.

I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.

J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

3.10 FINISHING

A. Flat Work:
   1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
   2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
   3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
   4. Tolerance for concrete floors shall be 1/4-inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
   5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
   6. The above finishes shall be used in the following locations:
      a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
      b. Light Troweled Finish: Submerged tank slabs.
      c. Hard Troweled Finish: Building floors.
      d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.

B. Formed Surfaces:

1. Within two days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots which appear shall be repaired to the satisfaction of ENGINEER. No extra compensation will be allowed CONTRACTOR for such work.
2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner as to insure complete filling of the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
    a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free and uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all painted surfaces, interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other approved method to achieve a texture similar to 40-60 grit sandpaper.
    b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof and moistureproof coated surfaces.
    c. Finish C shall be referred to as a finish which has surface imperfections less than 3/8-inch in any dimension. Surface imperfections greater than 3/8-inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
    d. Finish D shall be the finish for surfaces which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2-inch in

any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.

C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

3.11 LOADING OF CONCRETE STRUCTURES

A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.

B. Extreme care shall be taken to insure that construction loads do not exceed design loading of the structure.

3.12 NONSHRINK GROUT

A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

3.13 TESTING AND SAMPLING

A. The following tests of fresh concrete shall be performed by CONTRACTOR. CONTRACTOR shall prepare, protect, transport, and have tested all cylinders at his expense.
   1. Cylinders:
      a. Three test cylinders shall be made for each pour less than 25 cubic yards, 4 test cylinders shall be made for each pour between 25 and 100 cubic yards, and 8 test cylinders made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least 4 cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
      b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the job site.
      c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
      d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test result shall be mailed immediately and directly to ENGINEER. Test data shall include date and location of pour and concrete mix used.
   2. Slump Test: CONTRACTOR shall make one slump test at the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143. CONTRACTOR shall furnish ENGINEER with a slump cone and rod to use in performing extra tests.

3. Air Test:
   a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR at the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards.
   b. The air contents shall be checked using the pressure method (ASTM C231). The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
   c. CONTRACTOR shall furnish, and make available to ENGINEER, all necessary equipment for making extra tests of the air content.

B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

3.14 RECORDS

A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The project representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

3.15 GROUT TOPPING AND FILL

A. Before the grout topping is applied, the base slab shall be thoroughly cleaned. The base slab shall be wetted and kept saturated prior to placing the topping. A thin coat of cement grout shall be broomed into the base slab for a short distance ahead of the topping. The topping shall be applied before the grout is hardened.

B. Grout shall contain pea-gravel, crushed stone, or other suitable coarse aggregate graded from 1/8-inch to 3/8-inch in addition to well graded sand. Use seven bags of Portland cement per cubic yard. Not more than five gallons of mixing water per bag of cement, including free water in aggregate, shall be used.

3.16 CONCRETE REMOVAL AND PATCHING

A. All areas disturbed due to concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

3.17 SEALING

A. Install in accordance with manufacturer's instructions.

B. Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to walk on after troweling.

C. Spray on at rate of 200 square feet per gallon.

D. Keep surfaces wet with cure-seal-hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather slipperiness may appear before the 30-minute time period has elapsed. If that occurs, apply more cure-seal-hardener as required to keep entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state.

E. After this period, when treated surface becomes slippery, lightly mist with water until slipperiness disappears.

F. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal-hardener.

G. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.

H. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.

I. Protect installed floors until chemical reaction process is complete; at least three months.

J. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.

K. Protection and cleaning of floors are the responsibility of CONTRACTOR until final completion. Replace concrete that becomes stained due to improper precautions or lack of cleaning.

END OF SECTION

SECTION 03415

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Precast concrete hollow core planks.
   2. Connection plates and hangers.
   3. Grouting plank joint keys.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ACI 318–Building Code Requirements for Reinforced Concrete.

B. ASTM C150–Portland Cement.

C. AWS D1.1–Structural Welding Code.

D. AWS D1.4–Structural Welding Code–Reinforcing Steel.

E. PCI–Manual For The Design of Hollow Core Slabs.

F. PCI MNL-116–Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

G. PCI MNL-120–Design Handbook–Precast and Prestressed Concrete.

H. PCI MNL-123–Manual on Design of Connections for Precast Prestressed Concrete.

I. PCI–Design Handbook–Precast and Prestressed Concrete.

J. PCI–Tolerances for Precast and Prestressed Concrete.

1.03 DESIGN REQUIREMENTS

A. Size components to withstand design loads in an unrestrained condition as follows:
   1. Roof Assembly: All dead loads plus 25 psf live loads plus concentrated loads shown on the Drawings. At pitched roof structures, the loads will be transmitted to the panels through the attic stud walls. Increased loading due to snow drifting at obstructions and changes in roof elevation shall be included in the design.

B. Plank shall be designed in accordance with the PCI–Manual For The Design of Hollow Core Slabs and PCI–Design Handbook.

C. Plank shall be capable of resisting shear forces as a diaphragm. Diaphragm chords will be the masonry bond beams.

1.04 SUBMITTALS

A. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.

B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.

1.05 QUALIFICATIONS

A. Fabricator: Company specializing in manufacturing the work of this section with three years experience. Maintain plant records and quality control program during production of precast planks. Make records available upon request.

B. Erector: Company specializing in erecting the work of this Section approved by fabricator.

C. Design precast concrete members in accordance with PCI Manual For The Design of Hollow Core Slabs under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Kentucky.

D. Welder: Qualified within previous 12 months in accordance with AWS D1.1.

1.06 REGULATORY REQUIREMENTS

A. Conform to ACI 318 and the Kentucky Building Code for design load and on-site construction requirements.

B. CONTRACTOR shall submit additional copies of shop drawings for submittal to the local building code official by ENGINEER.

1.07 PRE-INSTALLATION CONFERENCE

A. Convene minimum one week prior to commencing work of this section under provisions of Section 01039–Coordination, Field Engineering and Meetings.

B. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Lifting or handling devices shall be capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

B. Mark each member with date of production and final position in structure.

1.09 COORDINATION

A. Coordinate the work of framing components not post tensioned but directly associated with the work of this section.

B. Coordinate field cut openings with affected section.

C. Coordinate location of hanger tabs and devices for mechanical and electrical work.

D. Coordinate location of anchors to be placed in masonry walls.

PART 2–PRODUCTS

2.01 FABRICATORS

A. The plank shall be prestressed hollow-core precast concrete plank as fabricated by deAM-Ron Building Systems, Flexicore Company, or equal.

2.02 MATERIALS

A. Materials shall comply with provisions of ACI 318.

B. Cement grout for grouting joints shall be one part Portland Cement per ASTM C150, three parts sand and water.

2.03 ACCESSORIES

A. Connecting and supporting devices shall be ASTM 304 stainless steel unless noted otherwise.

B. Bearing pads shall be high-density plastic, 1/8-inch-thick.

C. Caulk as approved by plank manufacturer.

2.04 FABRICATION

A. Conform to AWS D1.4., PCI MNL-116, and PCI MNL-120, and PCI MNL-123.

B. Embed anchors, inserts, plates, angles, and other items at locations indicated.

C. Cut exposed ends flush.

2.05 FINISHES

A. Plank to be painted shall be field abrasive blasted and painted as specified in Section 09900--Painting.

2.06 FABRICATION TOLERANCES

A. Conform to PCI–Tolerances for Precast and Prestressed Concrete.

PART 3–EXECUTION

3.01 EXAMINATION

A. Verify that site conditions and supporting structure are ready to receive work and field measurements are as indicated on shop drawings.

3.02 PREPARATION

A. Prepare support devices for the erection procedure and temporary bracing.

3.03 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and end joints as erection progresses.

C. Maintain temporary bracing in place until final connection is made. Protect members from staining.

D. Install bearing pads at bearing ends of planks as indicated.

E. Adjust differential camber between precast members to tolerance before final attachment and grouting.

F. Adjust differential elevation between precast members to tolerance before final attachment.

G. Grout plank joints, trowel smooth. Any grout that may have seeped through to the ceiling below shall be removed before it hardens. Grout shall also be placed between masonry and underside of roof plank in spaces created by roof plank camber over all exterior walls and bearing walls. On nonbearing interior walls, a void over 1/2-inch shall be filled with 1/2-inch expansion material and grout the remainder. This grout shall be applied following roofing. It is the intent that a space of 1/4-inch to 1/2-inch be left for caulking as required in Section 07900–Caulking and Sealants.

H. Underside of joints between planks that remain exposed shall be caulked with the plank manufacturer's material.

I. Where open cores at end of planks are to remain exposed to view. The cores shall be grouted full for a minimum 6-inch depth to provide finished end of plank.

J. Secure units in place. Perform welding, where shown, in accordance with AWS D1.1.

3.04 ERECTION TOLERANCES

A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-116.

3.05 CUTTING OPENINGS

A. Cooperation shall be extended all trades in permitting the insertion of anchors, hangers, vents, electrical outlets, etc. Holes needed for such devices shall be cut in the field by the

various trades. Cuts shall be made with a masonry saw or core drill. The various trades shall be present during installation of the roof deck. All openings not dimensioned or shown on the Drawings shall be located by the trades requiring the openings. All openings larger than 8 inches in any dimension shall be made by the roof slab supplier, and where necessary, hangers shall be furnished by the supplier. All spalling shall be repaired by the roof plank supplier prior to caulking. It is essential that plank which will remain exposed from below have a neat finished surface. Particular care shall be given to appearance of holes and openings.

END OF SECTION

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1–GENERAL

1.01 SUMMARY

A. The work includes mortar and grout for masonry.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. 2002 Kentucky Building Code.

B. ASTM C144–Aggregate for Masonry Mortar.

C. ASTM C150–Portland Cement.

D. ASTM C207–Hydrated Lime for Masonry Purposes.

E. ASTM C404–Aggregates for Masonry Grout.

F. ASTM C476–Grout for Masonry

G. ASTM C979–Pigments for Integrally Colored Mortar/Concrete.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.

C. Submit design mix for grout including gradation of aggregates.

D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

1.05 ENVIRONMENTAL REQUIREMENTS

A. See Section 04300–Unit Masonry System, for cold weather requirements.

PART 2–PRODUCTS

2.01 MORTAR

A. Portland cement shall conform to ASTM C150, Type I or III with an approved integral waterproofing compound added, Dry-Block by W.R. Grace Company or equal. Masonry cements will not be permitted.

B. Hydrated lime shall conform to ASTM C207, Type S.

C. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

Sieve Number	Percent by Weight Passing
4	100
8	95 to 100
16	70 to 100
30	40 to 75
50	10 to 35
100	2 to 15
200	---

D. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.

E. Water used in mixing water shall be clean and free of injurious materials.

F. Mortar shall be Type S with proportion restrictions as stated in the 2002 Kentucky Building Code. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.

G. Colored mortar shall be provided for split face block mortar. Colored mortar shall be Western Colored Masons Blend, premixed and colored as manufactured by Western Lime and Cement Company or equal. Color shall be selected by OWNER. White cement and sand will not be required.

2.02 GROUT

A. Grout shall conform to ASTM C476–Mortar and Grout for Reinforced Masonry.

B. Aggregates shall conform to ASTM C404–Aggregates for Masonry Grout.

C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
   1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
   2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.

D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inches and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

PART 3–EXECUTION

3.01 INSTALLATION

A. Brace masonry for wet grout pressure.

B. Work grout into masonry cores and cavities.

C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.

D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the Drawings.

END OF SECTION

SECTION 04300

UNIT MASONRY SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Concrete block.
   2. Split-face block.
   3. Reinforcement, anchorage, control joints, and accessories.
   4. Cold weather requirements.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. 2002 Kentucky Building Code.

B. ASTM C67--Sampling and Testing Brick and Structural Clay Tile.

C. ASTM C90–Load Bearing Concrete Masonry Units.

D. ASTM C744–Pre-Faced Concrete and Calcium Silicate Masonry Units.

E. UL–Fire Resistance Directory.

1.03 QUALITY ASSURANCE

A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4-inch in 10 feet, 3/8-inch in a story height or 20 feet maximum, nor 1/2-inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4-inch in any story or 20 feet maximum nor 1/2-inch in 40 feet or more.

B. Variation from the level of the grades indicated on the Drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4-inch in any bay or 20 feet nor 1/2-inch in 40 feet or more.

C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2-inch in any bar or 20 feet maximum nor 3/4-inch in 40 feet or more.

D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4-inch nor plus 1/2-inch from the dimensions indicated on the Drawings.

1.04 MOCK-UP

A. Provide a 4-foot by 4-foot mock-up panel of masonry, including anchor accessories and flashings, before any masonry work begins. Location will be indicated by OWNER. Mock-up panel shall be approved by OWNER and used as a sample of the quality of work to be expected on the job. Mock-up may not remain as part of the work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean, and shall be covered with waterproof cover.

1.06 COLD WEATHER REQUIREMENTS

A. All masonry units delivered to use in freezing weather shall be fully protected by a weather-tight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.

B. Cold Weather Protection:
   1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
   2. Remove all masonry determined to be frozen or damaged by freezing conditions.
   3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
      a. When air temperature is from 32°F (0°C) to 25°F (-4°C) heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
      b. When air temperature is from 25°F (-4°C) to 20°F (-7°C) heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
      c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).
   4. Perform the following protections for completed masonry and masonry not being worked on:
      a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
      b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.
      c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.
      d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat.

PART 2–PRODUCTS

2.01 CONCRETE BLOCK

A. Concrete block shall be load bearing and shall conform to the requirements of ASTM Designation C90 and the 2002 Kentucky Building Code. Bond shall be running bond. Concrete block shall be the two-cell type and shall be made with normal weight aggregate.

B. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.

C. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.

2.02 DECORATIVE CONCRETE BLOCK

A. Split Face and Smooth Face Block:
   1. Split face units shall be used for exterior veneer. Smooth face units shall be used where shown on the Drawings. Nominal face size of units shall be 8 inches by 16 inches. Nominal thickness shall be as shown on the Drawings.
   2. The block shall be made with an integral coloring compound and an integral waterproofing compound. The block shall be made with normal weight aggregate and shall meet ASTM C33 and ASTM C90.
   3. The integral waterproofing compound shall be DRY-BLOCK SYSTEM, Block Admixture as manufactured by W.R. Grace & Co., Cambridge, MA, or equal. The admixture manufacturer shall determine the amount of compound to be used. The admixture used in the block shall be of the same manufacture as used in the mortar.
   4. Block colors shall be selected by OWNER.

2.03 REINFORCEMENT AND ANCHORAGE

A. For concrete block walls, masonry wall reinforcement shall be Dur-O-Wal Truss Design manufactured by Dur-O-Wal Products, Blok-Trus manufactured by AA Wire Products Co., or equal.

B. For cavity walls, masonry wall reinforcement shall be Dur-O-Wal Truss/Dur-O-Eye Design, or Econo-Cavity Blok-Trus AA 680, or equal.

C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.

D. Side rods shall be 9 gauge wire, and cross rods and tabs shall be 9 gauge wire. Maximum spacing of tabs shall be 24 inches.

E. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.

F. Masonry Ties to Stud Walls: Ties shall be minimum 22 gauge corrugated sheet steel, 7/8-inch-wide with one tie per 2 square feet of wall area.

2.04 ACCESSORIES

A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be U.V.-resistant polypropylene, Durowall D/A 1006, or equal.

B. Vertical expansion control joints shall be as shown on standard detail drawings and located as shown on the Drawings. Control joints shall be constructed with a factory extruded section of rubber equal to Dur-O-Wal Rapid Control Joint, AA Wire Products Co. Titewall, or equal and shall extend for the entire height of the wall. Care shall be taken to insure that the gap is free of mortar or debris. Control joint shall be caulked on exposed faces with caulk of a color to match mortar.

C. See Section 07620–Flashing and Sheet Metal for masonry flashing specifications.

PART 3–EXECUTION

3.01 MASONRY WORKMANSHIP

A. All masonry shall be laid plumb and true to lines. Mortar beds shall be spread smooth or only slightly furrowed.

B. All masonry shall be laid in running bond, unless specified otherwise.

C. In laying block masonry, the mason shall avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.

D. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins which protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.

E. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods which provide cuts that are straight and true.

F. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections which might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.

G. Weep holes spaced 32-inch on center 2 1/2 inches high shall be provided in the first course immediately above all flashing. Weep holes shall be kept free of mortar droppings.

H. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4-inch nor more than 3/8-inch-wide and shall be cleaned out to a uniform depth of at least 3/4-inch ready for placement of caulk.

I. All walls shall be adequately braced until they are completed and anchored to the roof construction.

J. Construction designated as requiring "special observation" shall be constructed only in the presence of ENGINEER.

K. All brick having initial rates of absorption in excess of 0.25 ounce per square inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting of units shall be such as to insure that each unit is nearly saturated, surface dry when laid. During freezing weather, units that require wetting shall be sprinkled with warm water just before laying.

3.02 MORTAR JOINTS

A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8-inch-thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8-inch-thick, unless otherwise shown. All joints shall be completely filled.

B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.

3.03 REINFORCEMENT AND ANCHORAGE

A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical intervals or as shown on the Drawings. Reinforcement in the second joint above and below openings shall extend 2 feet beyond the jambs. All other reinforcing shall be continuous.

B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to assure a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.

3.04 BUILT-IN WORK

A. As work progresses, install all built-in work (such as: window and door frames, anchor bolts, plates, lintels, etc.) to be provided by other sections.

B. Install built-in items plumb and level.

C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."

D. Do not build-in organic materials subject to deterioration.

3.05 PARGING

A. Dampen masonry walls prior to parging.

B. Steel members embedded in exterior masonry shall be "buttered" with not less than 1/2-inch of setting mortar on all surfaces.

3.06 JOINING OF WORK

A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout four inches back of the rack. Toothing will not be permitted.

3.07 PROTECTION OF WORK

A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least two feet on each side of the wall and shall be securely anchored.

3.08 MASONRY CONTROL JOINTS

A. Provide vertical masonry control joints in block as detailed on the Drawings.

B. Where control joint locations are not shown on the Drawings, they shall be provided as follows:

	Block Veneer
Distance from wall corner (maximum)	12 feet
Spacing between joints (maximum)	20 feet

C. Where possible, joints shall be located at edges of door, window, and louver openings, and at changes in wall height.

3.09 CLEANING NEW WORK

A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5 or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Structural carbon steel framing members.
   2. Steel base plates and bearing plates.
   3. Structural steel bolted connections and anchor bolts.
   4. Welding of structural steel.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. AISC–Code of Standard Practice–Manual of Steel Construction–Allowable Stress Design (ASD).

B. ASTM A36/A36M–Structural Steel.

C. ASTM A53–Pipe, Steel, Black, and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

D. ASTM A123–Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.

E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A307–Carbon Steel Externally Threaded Standard Fasteners.

G. ASTM A325–High-Strength Bolts for Structural Steel Joints.

H. ASTM A500–Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

I. ASTM A992/A992M–Standard Specification for Structural Steel.

J. AWS A2.4–Symbols for Welding, Brazing, and Nondestructive Examination.

K. AWS D1.1–Structural Welding Code.

L. SSPC (Steel Structures Painting Council)–Painting Manual.

1.03 SUBMITTALS FOR REVIEW

A. Comply with pertinent provisions of Section 01300–Submittals.

B. Provide shop drawings with complete details and schedules for fabrication and shop assembly of members.
   1. Include details of cuts, connections, camber, holes, and other pertinent data.
   2. Indicate welds by AWS symbols, and show size, length, and type of weld.
   3. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages.
   4. Identify details by reference to sheet and detail number on the drawings.

C. Unless shown otherwise, all connections shall be designed and detailed by the fabricator to support one-half of the total uniform load capacity shown in the tables for uniform load constants in the AISC Specifications.

D. Except as shown otherwise, structural steel details shall conform to standard practice as illustrated in Structural Shop Drafting Textbook of the AISC.

E. Indicate all temporary bracing or cabling required to stabilize the structural frame during erection.

1.04 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC Code of Standard Practice.

B. Mill Test Reports: Submit indicating structural strength and composition.

C. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.05 QUALIFICATIONS

A. Qualify welding processes and welding operators in accordance with AWS "Standard Qualifications Procedures."

B. CONTRACTOR shall design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Kentucky.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Store all members off the ground using pallets, platforms, or other supports.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.

D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2–PRODUCTS

2.01 MATERIALS

A. Structural Steel Members:
   1. ASTM A36/A36M (channels, angles, plates).
   2. ASTM A992-50 (wide flange sections).

B. Bolts, Nuts, and Washers: ASTM A307 or ASTM A325, galvanized in accordance with ASTM A123 and A153.

C. Anchor Bolts: ASTM A307.

D. Welding Materials: AWS D1.1; E70XX electrodes.

E. Galvanizing: ASTM A123 and A153 for structural steel plates, shapes and bars, and structural steel tubing. ASTM A53 for steel pipe.

2.02 FABRICATION

A. Fabrication and Assembly:
   1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
   2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
   3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
   4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
   5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

B. Connections:
   1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
   2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
   3. Assemble and weld built-up sections to produce true alignment of axes without warp.
   4. Welding shall be done by the shielded arc process.
   5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.

C. Holes for Other Work:
   1. Provide holes for securing other work to structural steel framing and for the passage of other work through steel framing members as indicated.
   2. Provide threaded nuts welded to framing and other specialty items as shown to receive other work.
   3. Drill, cut, or punch holes perpendicular to metal surfaces.
   4. Do not flame cut holes or enlarge holes by burning.
   5. Drill holes in all bearing plates.

2.03 FINISH

A. Before shipping, prepare structural component surfaces in accordance with SSPC SP 10.

B. Immediately after surface preparation, shop prime structural steel members in accordance with Section 09900–Painting. Do not prime surfaces that will be field-welded, galvanized, or high-strength bolted with friction-type connection.

C. Surfaces which will be inaccessible after assembly or erection shall be field finish coated prior to assembly or erection.

PART 3–EXECUTION

3.01 EXAMINATION

A. Correct conditions detrimental to proper and timely completion of the work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 ERECTION

A. General: Comply with AISC Specifications and Code of Standard Practice and as specified herein.

B. Surveys:
1. Establish permanent bench marks necessary for the accurate erection of structural steel.
2. Check elevations of concrete and masonry, bearing surfaces, and locations of anchor bolts and similar items before erection proceeds.

C. Temporary Shoring and Bracing:
1. Provide temporary shoring and bracing members with connection of sufficient strength to bear imposed loads.
2. Provide temporary guidelines to achieve proper alignment of the structures as erection proceeds.
3. Remove temporary connections and members when permanent members are in place and final connections are made.

D. Anchor Bolts:
1. Provide anchor bolts and other connectors for securing structural steel to foundations and other in-place work.
2. Provide templates and other devices as needed for the presetting of bolts and other anchors to accurate locations.

E. Setting Bases and Bearing Plates:
1. Clean bearing surfaces free from bond-reducing materials and then roughen to improve bond to surface.
2. Set loose and attached base plates and bearing plates for structural members using wedges, leveling nuts, or other adjusting devices.

3. Tighten anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edges of the base or bearing plates prior to packing with grout.
4. Pack grout solidly between bearing surfaces and bases to ensure that no voids remain.
5. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's instructions.

F. Field Assembly:
1. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before fastening permanently.
2. Clean the bearing surfaces and other surfaces which will be in permanent contact before assembly.
3. Perform necessary adjustments to compensate for discrepancies in elevation and alignment.
4. Level and plumb individual members of the structure within specified AISC tolerances.
5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

G. Gas Cutting:
1. Do not use gas cutting torches in the field for correcting fabricating errors in the structural framing.
2. Cutting will be permitted only on secondary members which are not under stress as acceptable to ENGINEER.
3. When gas cutting is permitted, finish the sections equal to the sheared appearance.

H. After erection, prime welds, abrasions, and surfaces not shop-primed or galvanized, except surfaces to be in contact with concrete.

3.03 FIELD QUALITY CONTROL

A. CONTRACTOR shall inspect all field-bolted connections in accordance with the AISC Specifications.

B. Field Welding:
1. CONTRACTOR shall visually inspect all welds and test during erection of structural steel.
2. CONTRACTOR shall certify welders and conduct inspections and tests as required by applicable standards.
3. CONTRACTOR shall record types and locations of defects found and record the work required and performed to correct deficiencies.

C. Correction:
1. Correct deficiencies in structural steel work which inspections and test reports have indicated to be not in compliance with the specified requirements.
2. CONTRACTOR shall perform all additional testing required to show compliance of corrected work.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Shop-fabricated carbon steel, stainless steel, and aluminum items, including lintels, metal stairs, and trench drains.
   2. Stair nosings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A36–Structural Steel.

B. ASTM A53–Pipe, Steel, Black, and Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

C. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A143–Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A176–Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.

G. ASTM A307–Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

H. ASTM A384–Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

I. ASTM A385–Practice for Providing High Quality Zinc Coatings (Hot-Dipped).

J. ASTM A570–Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.

K. ASTM A611–Steel Sheet, Carbon, Cold-Rolled, Structural Quality.

L. ASTM B209–Aluminum and Aluminum-Alloy Sheet and Plate.

M. ASTM B211–Aluminum-Alloy Bar, Rod, and Wire.

N. ASTM B221–Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.

O. AWS A2.0–Standard Welding Symbols.

P. AWS D1.1–Structural Welding Code.

1.03 DESIGN REQUIREMENTS

A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

A. Comply with pertinent provisions of Section 01300–Submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

A. Fabricate steel members in accordance with AISC Code of Standard Practice.

B. Mill Test Reports: Submit indicating structural strength and composition.

C. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 QUALIFICATIONS

A. Qualify welding processes and welding operators in accordance with AWS "Standard Qualifications Procedures."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Store all members off the ground using pallets, platforms, or other supports.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.

D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

PART 2–PRODUCTS

2.01 MATERIALS–CARBON STEEL

A. Steel Sections:
1. ASTM A36 (channels, angles, plates).

2. ASTM A992-50 (wide flange sections).
3. Pipe: ASTM A53, Grade B.
4. Tubes: ASTM 500, Grade B.

B. Sheet Steel: ASTM A570 or A611.

C. Plain Washers: Round carbon steel complying with FS FF-W-92.

D. Bolts and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.

E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.

F. Welding Materials: AWS D1.1; E70XX electrodes.

G. Select fasteners for the type, grade, and class required.

2.02 MATERIALS–STAINLESS STEEL

A. Unless otherwise noted, all stainless steel shall meet the requirements of ASTM A240 and shall be Type 316L.

B. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.

2.03 MATERIALS–ALUMINUM

A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.

B. Sheet Aluminum: ASTM B209, Alloy 3005.

C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.

D. Bolts, Nuts, and Washers: Stainless steel Steel.

E. Welding Materials: AWS D1.1; type required for materials being welded.

2.04 ACCESSORIES

A. Nosings:
1. Stair tread nosing shall be provided on all interior concrete and steel pan stairs.

B. Trench Drain:
1. Trench drain shall be frame and grate system, welded structural components with anchor tabs, leveling devices, 3-inch stud anchors, and heavy duty cast iron grate. Acceptable products include Zurn 700 series fram and grate system, or equal.

2.05 FABRICATION

A. Fabrication and Assembly:
1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.

2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

B. Connections:
1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
3. Assemble and weld built-up sections to produce true alignment of axes without warp.
4. Welding shall be done by the shielded arc process.
5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.

C. Workmanship:
1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
2. Work to dimensions shown or accepted on the Shop drawings using proven details of fabrication and support.
3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
5. Cap all open ends of pipe and structural tubing.
6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

2.06 MISCELLANEOUS METAL FABRICATION

A. Metal Stairs:
1. Fit and shop-assemble components in largest practical sections for delivery to site.
2. Fabricate components with joints tightly fitted and secured.
3. Supply components for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
4. Treads and risers for metal pan stairs shall be fabricated with 14 gauge sheet stell, closed risers, treads ready to receive concrete.

2.07 FINISHES

A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09900–Painting.

B. Do not prime surfaces where galvanizing or field welding is required.

C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09900–Painting.

D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.

E. Surfaces which will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.

F. Galvanizing:
   1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
   2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in "Recommended Details for Galvanized Structures" as published by the American Hot Dip Galvanizer's Association, Inc.
   3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
   4. Steel shall conform to ASTM A36 except that the silicone content shall be in the range of 0 to 0.04%.
   5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
   6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, "Welding Zinc Coated Steel." All uncoated weld areas shall be touched up.

G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3–EXECUTION

3.01 EXAMINATION

A. Correct conditions detrimental to the proper and timely completion of the work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.

B. Coordinate delivery of such items to project.

C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Setting Precast Anchorages:
   1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
   2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
   3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

C. Cutting, Fitting and Placement:
   1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
   2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
   3. Fit exposed connections accurately together to form tight hairline joints.
   4. Weld connections which are not to be left as exposed joints, grind joints smooth, and touch-up shop paint coat or galvanizing repair.

3.04 FIELD WELDING

A. Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09900–Painting.

3.06 GALVANIZING REPAIR

A. Areas damaged by welding, flame-cutting or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16-inch in width.
   1. Cold Galvanizing Compound:
      a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
      b. Areas to be repaired shall be power disc-sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
      c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
      d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.

e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

2. Zinc-Based Solder:
   a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
   b. Areas to be repaired shall be wire brushed.
   c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
   d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

3.07 SCHEDULE

A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.

B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed; galvanized and field finish paint per Division 9.

C. Lintels: Shop prime paint finish for interior wall lintels; galvanized finish for exterior wall lintels. Lintels approved by ENGINEER shall be placed over all masonry openings. See lintel schedule on the Drawings.

D. Door Frames for Overhead Door Openings: Angle sections; shop prime paint finish.

E. Steel stairs, metal pan treads, shop-primed finish.

F. Trench drain.

END OF SECTION

SECTION 05520

HANDRAILS AND RAILINGS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes steel and aluminum handrails and fittings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM B241–Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

1.03 DESIGN REQUIREMENTS

A. Handrail shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the 2002 Kentucky Building Code.

PART 2–PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

A. Provide a mechanically joined pipe railing system, Tabco 2500 Railing System as manufactured by Tuttle Aluminum and Bronze Co. or equal.

B. Rails shall be ASTM B241, Aluminum Alloy 6063-T6, Schedule 40, 1 1/2-inch-diameter pipe extrusion.

C. Posts shall be ASTM B241, Aluminum Alloy 6063-T6, Schedule 40, 1 1/2-inch-diameter pipe.

D. Furnish and install 4-inch by 1/4-inch toeboards.

E. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall occur within 1 foot of posts.

F. Finished joints shall be smooth.

G. All rails, posts, toeboards, and connectors shall have a M12C22A41 clear anodized finish.

H. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria.

I. Stainless steel expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.

B. Install components plumb and level, accurately fitted, and free from distortion or defects.

C. Clean all components as recommended by railing manufacturer.

END OF SECTION

SECTION 05560

ANCHOR BOLTS, EXPANSION BOLTS, AND RESIN ANCHORS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Anchor bolts, expansion bolts, and resin anchors.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A36/A36M–Structural Steel.

B. ASTM F1554-Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.

PART 2–PRODUCTS

2.01 ANCHOR BOLTS

A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.

B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

2.02 EXPANSION BOLTS

A. Expansion bolts shall be Power-Bolt by Powers Fastening Systems or equal.

B. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.

C. Unless indicated otherwise on the Drawings or specified, use the following bolt material for the various installation situations:
   1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
   2. Steel: In other locations in contact with items to be painted or encased in concrete.

2.03 RESIN ANCHORS

A. Resin anchors shall be Powers Fastening Systems Power-Fast or equal.

PART 3–EXECUTION

3.01 ANCHOR BOLTS

A. Anchor bolts for structural members shall be located as shown and specified.

B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.

C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

3.02 EXPANSION BOLTS

A. Unless otherwise noted on the Drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's recommendations.

B. Bolt embedment shall at least equal six bolt diameters.

C. All procedures shall be in accordance with the manufacturer's recommendations.

D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and shall be located to clear reinforcing steel.

3.03 RESIN ANCHORS

A. At locations shown on the Drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.

B. All existing surfaces to receive resin anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.

C. All procedures shall be in accordance with the manufacturer's recommendations.

D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and bolts and shall be located to clear reinforcing steel.

END OF SECTION

SECTION 06112

WOOD FRAMING AND SHEATHING

PART 1–GENERAL

1.01 SUMMARY

A. Work included:
   1. Structural wall framing.
   2. Roof sheathing.
   3. Miscellaneous framing and sheathing.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ALSC–American Lumber Standards Committee.

B. APA–American Plywood Association.

C. AWPA–American Wood Preservers Association.

D. NFPA–National Forest Products Association.

E. NLGA–National Lumber Grades Authority.

F. SPIB–Southern Pine Inspection Bureau.

G. WCLIB–West Coast Lumber Inspection Bureau.

H. WWPA–Western Wood Products Association.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect lumber and other building materials and keep under cover both in transit and at the job site. Protect from dampness. Stack framing lumber and plywood to insure proper air circulation. Locate stacks on well-drained areas. Support 6 inches above grade and protect with waterproof cover.

PART 2–PRODUCTS

2.01 MATERIALS

A. Lumber shall be kiln-dried with moisture content not to exceed 19% at time of installation and grade marked according to the National Lumber Manufacturer's Association.

B. All studs shall be 2 inches by 4 inches nominal or 2 inches by 6 inches nominal as shown on the Drawings and shall be No. 2 Douglas Fir, No. 2 Southern Pine, or better.

C. Plywood roof sheathing shall be grade C-D Ext., or better, graded in accordance with the American Plywood Association.

D. Wood sills, plates, blocking, etc., to be same grade as studs.

PART 3–EXECUTION

3.01 FRAMING

A. General: All rough framing lumber and all other wood framing, studs blocking, and furring shall be accurately set to required lines and levels, closely fitted, shimmed, and rigidly secured in place.

B. Place all wood studs in sizes as shown and spaced at 16 inches o.c., unless noted otherwise. Erect studs on single bottom and single top plate at nonbearing walls, double studs at all openings, triple studs at corners. Install blocking between studs as required. Bolt plates and blocking to concrete at 32-inch centers, unless noted otherwise. Space framing to receive electrical piping or ductwork without cutting joist. Verify all duct and piping runs prior to framing to eliminate conflict. Stud walls shall extend a minimum of 8 inches above the ceiling line. Stud walls shall be adequately braced off of other stud walls and/or masonry walls.

C. Construct load bearing, framing, and curb members full length without splices.

D. Provide double studs at openings over 24 inches wide. Space short studs over and under opening to stud spacing.

3.02 PLYWOOD SHEATHING

A. Plywood sheathing shall be nailed at 6 inches on center at edges and 12 inches on center at intermediate supports with 8d common nails.

B. Secure roof sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing. Use sheathing clips between sheets between roof framing members, or provide solid edge blocking between sheets.

3.03 CONNECTIONS

A. All framing connections and nailing shall be in accordance with the details shown and/or the Kentucky Building Code minimum requirements, whichever is more restrictive.

B. Framing connectors shall be Simpson Strong Tie or equal. Connector numbers shown on details are Simpson. Submit engineering data on any substitutes.

C. Connectors shall be installed in accordance with manufacturer's requirements.

END OF SECTION

SECTION 06114

WOOD BLOCKING AND CURBING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Roof curbs and cants.
   2. Wood blocking.
   3. Wood furring and grounds.
   4. Preservative treatment of wood.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ALSC–American Lumber Standards Committee.

B. AWPA–American Wood Preservers Association.

C. NFPA–National Forest Products Association.

D. NLGA–National Lumber Grades Authority.

E. SPIB–Southern Pine Inspection Bureau.

F. WCLIB–West Coast Lumber Inspection Bureau.

G. WWPA–Western Wood Products Association.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01300–Submittals.

B. Certification of type of wood and wood treatment to be used.

1.04 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be thoroughly sealed and protected from weather during transport and at the job site. Protect from dampness.

PART 2–PRODUCTS

2.01 MATERIALS

A. Lumber for roof curbs, cants, blocking, furring, and grounds shall be "standard" grade Douglas Fir, No. 2 Southern Pine, or better, graded in accordance with the WWPA,

WCLIB, NLGA, or SPIB grading rules as applicable. Lumber shall bear the grading agency's stamp.

B. Wood shall be kiln-dried with moisture content not to exceed 19% at time of installation.

C. All lumber furnished under this section shall be pressure-treated with a chromated copper arsenite (CCA) waterborne preservative to a minimum retention of 0.40 pounds per cubic foot. Acceptable products include Hoover Treated Wood Products CCA, Wood Preserving Co. Osmose CCA, or equal. Cuts shall be treated in the field with a brush-on waterborne preservative compatible with the pressure treatment.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide and install wood curbs, cants, blocking, furring, and grounds of proper size and shape and where required to secure other work or equipment in place.

B. Members shall be installed true to lines, level, plumb, and secure.

C. Connections and nailing shall be in accordance with the details shown and/or the 2002 Kentucky Building Code minimum requirements, whichever is more restrictive.

D. Apply brush-on wood preservative treatment to cuts in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 06193

PLATE CONNECTED WOOD TRUSSES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All materials, equipment, and labor necessary for the prefabrication, delivery, and permanent setting of wood trusses on buildings.
   2. Bridging.
   3. Temporary and permanent bracing.
   4. Related hardware.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ALSC–American Lumber Standards Committee.

B. APA–American Plywood Association.

C. ASTM A167–Stainless and Heat-Resisting Chromium–Nickel Steel Plate, Sheet, and Strip.

D. ASTM A653–Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, (Structural Physical) Quality.

E. AWPA–American Wood Preservers Association.

F. NFPA–National Forest Products Association.

G. SPIB–Southern Pine Inspection Bureau.

H. TPI–Truss Plate Institute.

I. WWPA–Western Wood Products Association.

1.03 DESIGN REQUIREMENTS

A. Trusses shall be designed to carry all dead loads, live loads, snow loads, and wind loads in accordance with the 2002 Kentucky Building Code. Snow loads shall be calculated using a ground snow load of 15 psi, a snow load importance factor of 1.2, and snow exposure and thermal factors as per code. Design for unbalanced, sliding, and drifted snow loads.

B. Design for any concentrated loads as shown on Drawings.

C. Deflections shall be limited to 1/240 of span under live load.

D. All loads shall be in accordance with the Kentucky Building Code.

1.04 SUBMITTALS

A. Submittals shall be as in Section 01300–Submittals.

B. Professional Engineer: All truss designs shall bear the name and seal of a State of Kentucky Licensed Professional Engineer. CONTRACTOR shall be responsible for submitting the required materials to obtain approval of the truss drawings by the State of Kentucky, including fee and application form. These materials must be submitted to ENGINEER for his approval prior to fabrication.

C. Truss designs shall include the following information: Pitch, span, dimensions, and spacing of trusses; truss bearing sizes and locations; design loading of truss and allowable stress increase; axial forces in each truss member; nominal sizes and location of connector plates at all joints; size, species, and stress of grade of lumber for all truss members; camber; permanent lateral bracing as required by design to reduce buckling length of individual truss members; and handling and erection recommendations.

1.05 QUALITY ASSURANCE

A. The design and fabrication criteria of all wood trusses shall meet the following:
   1. "National Design Specifications for Stress-Grade Lumber and its Fastenings," by National Forest Products Association (latest revision).
   2. "Timber Construction Standards," by American Institute of Timber Construction (latest revision).
   3. "Design Specifications for Light Metal Plate Connected Wood Trusses," by Truss Plate Institute (latest revision).
   4. Kentucky Building Code.

B. Fabricator Manufacturer: Minimum three years experience in successful fabrication of trusses comparable to type indicated for this project.

C. Design Trusses under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Kentucky.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Fabricated trusses and subcomponents shall be so handled and stored that they are not subject to damage.

B. If the trusses are to be stockpiled prior to erection, sufficient bearing points and/or bracing shall be provided to prevent excessive lateral bending or tipping over.

PART 2–PRODUCTS

2.01 MATERIALS

A. Lumber:
   1. All lumber used for truss members shall be Spruce-Pine-Fir, Douglas Fir, Southern Pine, Hem-Fir, or Western Larch and shall conform to lumber for trusses and shall have a minimum nonrepetitive fiber bending strength of 1,050 psi. If design calls for

use of a lumber with greater strength, then that lumber shall be used for the associated members.

2. At the time of delivery, the moisture content of all lumber shall not exceed 19% kiln-dried.
3. All lumber shall conform to the species and shall be fully recognized nominal sizes shown on the Drawings or truss engineering design.
4. All members shall be cut from lumber which bear the proper grade-mark stamps of a licensed lumber inspection agency.

B. Connectors:

1. All truss connector plates shall be manufactured from ASTM A653, Grade A, prime commercial quality galvanized sheet steel of no less than 20 gauge thickness which has a minimum yield of 33,000 psi and a minimum ultimate tensile strength of 45,000 psi.
2. The corrosion-resistant coating shall be ASTM A924, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements; Coating Designation C90 or G60, or ASTM A591, Standard Specification for Electrolytic Zinc-Coated Steel Sheets," Coating Class C, or such treatment as will give equivalent corrosion protection.
3. The connectors shall have a series of nail-like projections which are designed to separate the fibers of the wood into which they are pressed in accordance with accepted nailing practices.
4. Where field-assembly of truss subcomponents is necessary, the connections shall be in accordance with the details shown on the truss design drawings, approved by a Professional Engineer.

2.02 FABRICATION

A. All trusses and other roof structural components shall be fabricated in a properly equipped manufacturing facility of a permanent nature. They shall be manufactured by experienced workmen using precision cutting and truss fabricating equipment under the direct supervision of a qualified foreman. All trusses shall be fabricated under strict rules of inspection and quality control as the local code may require and be open to the observation of ENGINEER or his representative at all times.

B. All truss members shall be accurately cut to length, angle, and be true to line to assure tight joints for finished truss.

C. All truss members and connector plates shall be properly placed in special jigs and the members tightly clamped in place remaining in that position until the connector plates have been pressed into the lumber simultaneously on both sides of the joints.

D. Camber shall be built into the trusses, as noted on the engineering truss designs, by properly positioning the members in the fabricating jog. No camber will be allowed on the bottom chord.

PART 3–EXECUTION

3.01 ERECTION

A. Install trusses in accordance with manufacturer's instructions and TPI BWT (latest revision).

B. Framing anchors and/or truss hangers shall be provided by CONTRACTOR, as required, or detailed to withstand all loads, both dead and live, as well as wind and transfer loads to bearing.

C. Field erection of the trusses, including items such as handling, safety precautions, and temporary bracing to prevent toppling or the domino effect on the trusses during erection, and any other safeguards or procedures consistent with good workmanship and good building erection practices, shall be employed.

D. During the entire construction period, all contractors shall provide means for adequate distribution of concentrated loads so that the carrying capacity of any one truss and/or other component is not exceeded.

E. Proper erection bracing shall be installed to hold the trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound roof framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads. Provide all permanent bracing necessary for truss stability.

F. Frame openings between trusses with lumber in accordance with Section 06112–Wood Framing and Sheathing.

END OF SECTION

SECTION 07120

FLUID APPLIED WATERPROOFING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Fluid applied elastomeric waterproofing membrane for below grade walls. Fluid applied waterproofing membrane is required on the earth side of exterior concrete walls which are below grade and are common with rooms, tunnels, or galleries to be occupied by equipment, piping, or personnel. Membrane is not required for walls which are poured directly against an excavated surface.

B. Fluid-applied elastomeric waterproofing membrane for below grade structures.

C. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NRCA (National Roofing Contractors Association)–Waterproofing Manual.

1.03 SUBMITTALS

A. Submit two samples of coating system applied to 1/4-inch plywood or similar rigid base.

B. Submit list of at least five projects of similar nature by waterproofing applicator which have been installed within the last five years, identified with project name, location, and date.

C. Submit letter from membrane manufacturer stating that applicator is an approved or certified applicator of their product.

D. Submit copies of warranty.

1.04 QUALIFICATIONS OF APPLICATOR

A. Membrane applicator shall be approved by the manufacturer and shall have a minimum of 5 years experience in application of fluid-applied waterproofing coatings.

1.05 ENVIRONMENTAL CONDITIONS

A. No waterproofing work shall be performed at ambient temperatures below 40°F.

B. No waterproofing work shall be performed during inclement weather or when such weather is imminent.

1.06 WARRANTY

A. Provide installer's five-year total system warranty of water-tightness covering cost (labor and materials) to repair any leaks in the waterproofing membrane, including cost to remove backfill material or other materials concealing the membrane, if required.

PART 2–PRODUCTS

2.01 MEMBRANE

A. Membrane shall be fluid-applied, single-component, modified, moisture-curing polyurethane elastomer.

B. Acceptable products include the following, or equal: Tremproof 60, manufactured by Tremco.

2.02 ACCESSORIES

A. Cleaners and conditioners, primers, sealants, backer rod, flashing and flashing reinforcements, and other accessories related to the membrane application shall be provided as required by the membrane manufacturer.

B. Provide 1/8-inch-thick protection board, Tremboard by Tremco, or equal.

PART 3–EXECUTION

3.01 SURFACE PREPARATION

A. Surface preparation shall be in accordance with the membrane manufacturer's recommendations.

B. Verify that curing methods used for concrete are compatible with the membrane system.

C. Concrete surfaces shall be free of laitance, loosely adhering materials, oil, curing compounds, and all other contaminants prior to membrane application. Prepare all concrete surfaces by sandblasting followed by vacuum cleaning or by acid etching.

D. Concrete surfaces shall be visibly dry and shall pass a 4-hour rubber mat test (no condensation) prior to application of coating system. Mat shall be taped to deck on all edges.

3.02 PRODUCT APPLICATION

A. Preparatory work (priming and flashing) must be fully cured in accordance with manufacturer's recommendations prior to coating application.

B. Apply coating in accordance with manufacturer's recommendations using approved squeegee, trowel, or spray equipment to produce a 60 mil wet film thickness (Tremproof 60). This is in addition to the primer and flashing coats. Extend coating over all previously flashed and primed areas.

C. The membrane shall be cured as recommended by the manufacturer prior to water testing, backfilling, or allowing foot traffic on surfaces.

D. Horizontal surfaces shall be flooded to a depth of 2 inches maintained over a 12-hour period. Any leaks evident after this period shall be repaired and the leaky areas retested until leaks are stopped.

E. Apply protection board to all surfaces prior to backfilling.

END OF SECTION

SECTION 07191

VAPOR AND AIR BARRIER

PART 1–GENERAL

1.01 SUMMARY

A. Work includes:
   1. Vapor barrier under concrete floors on grade and on top of precast roof plank.
   2. Air barrier on exterior stud wall sheathing.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS

A. Vapor barrier shall consist of 10 mil polyethylene sheeting for below slabs and 6 mil for exterior wall construction vapor barrier shall be Class B with less than 0.3 perm water vapor permeance in accordance with ASTM E1745.

B. Air barrier shall be a flash spun bonded olefin, non-woven, non-perforated secondary weather resistant barrier, Type K Commercial Wrap by Dupont, or equal. Provide Tyvek tape and wrap cap screws.

PART 3–EXECUTION

3.01 INSTALLATION–UNDER CONCRETE FLOORS ON GRADE

A. Provide continuous vapor barrier under concrete floors on grade that are 8 inches or less in thickness, lap all joints a minimum of 12 inches.

B. Place 6 inches of granular cushion over vapor barrier.

3.02 INSTALLATION ON TOP OF PRECAST ROOF PLANK

A. Provide continuous vapor barrier on top of precast plank.

B. Lap all joints a minimum of 12 inches and tape all joints.

3.03 INSTALLATION OF AIR BARRIER

A. Install air barrier on exterior side of exterior wall sheathing.

B. Install air barrier per manufacturer's recommendations and approved details.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work includes board insulation for cavity wall construction, for perimeter foundation walls, and under floor slabs-on-grade.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 CAVITY WALL INSULATION

A. Cavity wall insulation shall be 1 1/2-inch-thick polyisocyanurate foam board with foil facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 10.0.

B. Acceptable products include the following, or equal. Celotex Thermax by Celotex Corporation.

C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.

2.02 FOUNDATION AND UNDER-SLAB INSULATION

A. Foundation and under-slab insulation shall be 2-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 10.0.

B. Acceptable products include the following, or equal:
   1. Styrofoam Square Edge by Dow Chemical Company.
   2. Foamular 250 by UC Industries, Inc.

PART 3–EXECUTION

3.01 INSTALLATION–CAVITY WALLS

A. Insulation shall be installed horizontally within the cavity space between masonry wythes.

B. Take care during installation to ensure all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.

C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.

D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.

3.02 INSTALLATION–FOUNDATION WALLS AND UNDER FLOORS

A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.

B. At perimeter frost wall foundations, insulation shall be 30 inches high and located on the inside of foundation walls.

C. At foundation walls that extend above a building floor level (including basement floor) and are partially or fully buried, insulation shall be 30 inches high and located on the outside of the walls, with top of insulation terminating 4 inches below finished grade.

D. Insulation under edges of slab-on-grade floors shall be 24 inches wide.

END OF SECTION

SECTION 07213

BATT INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work includes batt insulation for attic spaces.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM C665–Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

PART 2–PRODUCTS

2.01 EXTERIOR WALL AND ROOF INSULATION

A. Batt insulation placed on top of precast plank in attic spaces shall be unfaced fiberglass batt 12 inches thick conforming to ASTM C665, Type 1, and providing a minimum R-value of 38. Two layers of 6-inch batt placed perpendicular to each other may be used in place of one layer of 12-inch batt.

B. All batt insulation in attic spaces shall be unfaced or foil-reinforced kraft faced meeting the Kentucky Building Code or governing local building code requirements.

C. Acceptable manufacturers include the following or equal:
1. Owens Corning.
2. Manville.
3. Certainteed.

PART 3–EXECUTION

3.01 INSTALLATION–ROOF INSULATION

A. Prior to installing insulation, vapor barrier shall be in place (See Section 07191–Vapor Barrier).

B. Insulation shall be loose laid on the precast plank over the vapor barrier. If two layers of insulation are used to make up the required thickness, upper layer shall be installed perpendicular to the lower layer.

END OF SECTION

SECTION 07216

LOOSE FILL INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work includes granular insulation in cells of concrete masonry units.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM C516–Vermiculite Loose Fill Insulation.

B. ASTM E84–Surface Burning Characteristics of Building Materials.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include the following, or equal: Zonolite Masonry Insulation as manufactured by W.R. Grace & Co.

2.02 MATERIALS

A. Loose fill insulation shall be vermiculite type meeting ASTM 516. Insulation shall be water-repellent, fire-resistant, and shall have flame spread and smoke developed ratings of 0 in accordance with ASTM E84.

PART 3–EXECUTION

3.01 PREPARATION

A. Verify spaces are free of mortar to allow free flow of insulation.

B. Verify holes and openings have been sealed to prevent escape of insulation.

3.02 INSTALLATION

A. Place insulation as wall is erected. Completely fill spaces.

END OF SECTION

SECTION 07611

SHEET METAL ROOFING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Standing Seam Metal Roof System.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM 525–Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

B. SMACNA–Architectural Sheet Metal Manual.

C. NRCA–Roofing and Weatherproofing Manual (including construction details) and Handbook of Accepted Roofing Knowledge.

D. Manufacturer's Handbook of Construction Details.

E. AISI "Specifications for the Design of Light–Gauge Cold Formed Steel Structural Member, latest edition."

1.03 SUBMITTALS

A. See Section 01300–Submittals for general submittal requirements.

B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

C. Samples: Submit one sample of each type of prefinished and preformed panel showing color and profile match. Provide same for closures.

D. Warranty from manufacturer: Submit sample of manufacturer's 20-year warranty on weathertightness.

1.04 QUALITY ASSURANCES

A. Perform work in accordance with manufacturer's instructions and these specifications.

1.05 QUALIFICATIONS

A. Material Manufacturer: Five years documented experience with this type of construction.

B. Installer: Five years of satisfactory documented experience in the installation of this type of work.

1.06 WARRANTIES

A. Architectural finish coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

B. Warrant materials and workmanship for 20 years for weathertightness.

1.07 SYSTEM DESIGN

A. All components of the paneling system shall be designed in accordance with sound engineering methods and practices.

B. The panels shall be designed in accordance with AISI "Specifications for the Design of Light Gauge Cold Form Steel Structural Members," latest edition.

C. The paneling system and its attachments shall be designed to support live, snow, and wind loads.

D. The panel shall not be considered a safe work platform until completely secured to the structural system. Therefore, walkboards or other safety equipment, as required by safety standards, shall be provided by the erecting Contractor to provide worker safety during panel installation.

E. Panels shall be designed for 25 psf live load plus drift loads.

F. The roof system shall carry UL wind-uplift Class 90 rating.

PART 2–PRODUCTS

2.01 MATERIALS

A. Metal Roof System:
   1. Roof panels shall be roll formed panels 16 inches wide with two major corrugations, 2 1/2 inches high, 16 inches (equal to panel width) on center.
   2. Panel materials shall be 24 gauge hot-dipped galvanized steel (50,000 psi yield), G-90 coating conforming to ASTM A525 specification.

B. Fasteners:
   1. All connections of panels to structural members, except at eave, shall be made with clips with moveable tabs that are seamed into the standing seam sidelap.
   2. Panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawings.
   3. Panel-to-panel connections shall be made with a positive, field-formed standing double-lock seam, formed by a special seaming device.

C. Provide a 30-pound felt between plywood and roof panels over entire roof area except provide a fully adhered membrane, Grace Ice and Water Shield, or equal to 4 feet inside the exterior wall line.

2.02 MANUFACTURERS AND PRODUCTS

A. Roof panels shall be roll formed Stand N' Seam panels as manufactured by Fabral, or equal.

B. Sealants: Per Section 07900–Caulking and Sealants.

C. Flashing at eave, gable, ridge, and penetrations shall be in accordance with manufacturer's recommendations and Section 07620–Flashing and Sheet Metal.

2.03 FINISHES

A. Finishes on all exterior surfaces shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat.

B. All exposed fasteners shall be provided with the same finish as the sheet material products.

C. Colors shall be selected by OWNER.

PART 3–EXECUTION

3.01 INSTALLATION

A. The panels shall be attached to the supporting structurals by means of a clip device. The clip shall occur at the panel major corrugation.

B. Panel sidelaps shall be field-seamed by a seaming device; all sidelap sealant shall be factory applied.

C. Panel endlaps, when required, shall be at least 6 inches and sealed with field-applied sealant. One panel end shall be "swaged" to ensure nestible, watertight endlaps.

D. Provisions for thermal expansion/contraction movement of the panel shall be accomplished by the use of clips with a moveable tab. The tabs shall be factory-centered on the roof clip to ensure full movement in either direction.

E. The roof shall provide for thermal expansion/contraction without detrimental effect on the roof panel when there is a 100°F temperature differential between the interior structural framework of the building and the roof panels.

END OF SECTION

SECTION 07620

FLASHING AND SHEET METAL

PART 1–GENERAL

1.01 SUMMARY

A. Work includes masonry wall flashing, custom fabricated sheet metal flashing, and counter flashing at roof-mounted equipment, vent stacks, and other locations.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A653–Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

B. ASTM A924–General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.

C. ASTM B32–Solder Metal.

D. ASTM B209–Aluminum and Alloy Sheet and Plate.

E. ASTM D4586–Asphalt Roof Cement, Asbestos-Free.

F. SMACNA–Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. See Section 01300–Submittals for general submittal requirements.

B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA standard details and requirements.

1.05 QUALIFICATIONS

A. Fabricator and installer shall be a company specializing in sheet metal fabrication work with a minimum of five years of verifiable experience in that field.

1.06 WARRANTY

A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2–PRODUCTS

2.01 MATERIALS

A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER. Wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.

B. Galvanized steel sheet: 26-gauge meeting ASTM A525, Grade A with G90 zinc coating.

C. Aluminum sheet: 0.032-inch-thick meeting ASTM B209.

D. Fasteners: Same material and finish as flashing sheet. Stainless steel fasteners may be used with any flashing material. Provide soft neoprene washers with fasteners.

E. Primer: Zinc chromate type.

F. Protective Backing Paint: Bituminous type.

G. Sealant: See Section 07900–Caulking and Sealants.

H. Bedding Compound: Rubber asphalt or butyl type.

I. Plastic Cement: ASTM D4586, Type I or II.

J. Reglets: Galvanized steel or PVC, surface-mounted or recessed.

K. Solder: ASTM B32. Soldering is not permitted on aluminum or stainless steel sheet.

2.02 FABRICATION

A. All flashing and fascia shall be formed to the configurations shown on the Drawings and/or the applicable manufacturer's details, or in accordance with SMACNA standard details where not shown on the Drawings or in manufacturers details. Form sections true to shape, accurate in size, square, and free from buckles, kinks, or other defects.

B. All exposed edges shall be folded or returned on themselves at least 1/2-inch. Corners shall be mitered and seamed.

C. Form pieces in the longest possible lengths. Form material with flat lock seams.

D. All sections shall be provided with slip joints at 8 feet on center.

E. Cleats shall be fabricated of the same materials as the flashing sheets and shall be interlockable with the sheets.

F. Fabricate vertical faces with bottom edge formed outward 1/4-inch and hemmed to form a drip.

G. Fabricate corners from one piece with minimum 18-inch-long legs. Seam or solder for rigidity and seal with sealant.

2.03 FINISH

A. Back paint all sheet metal with asphaltum paint where sheet metal surfaces come in contact with masonry or steel.

B. Flashing and fascia shall be painted where exposed to view from the ground. Galvanized steel shall be painted in accordance with Section 09900–Painting. Aluminum shall be coated with a Kynar 500 coating system.

PART 3–EXECUTION

3.01 INSTALLATION

A. Through-wall flashing shall be installed 1/2-inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.

B. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and line accurate to profiles. Seal metal joints watertight.

C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by ENGINEER.

D. Insert flashings into reglets. Seal flashings into reglets with sealant.

E. CONTRACTOR shall provide copper sleeves for hot pipes penetrating the roof as approved by the roofing manufacturer. The annular space between the sleeve and the pipe shall be packed with insulation capable of withstanding the maximum temperature of the pipe. CONTRACTOR to provide a galvanized steel rain collar welded to the hot pipe.

END OF SECTION

SECTION 07631

GUTTERS AND DOWNSPOUTS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Aluminum gutters and downspouts.
   2. Precast concrete splash pads.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM B209–Aluminum and Aluminum Alloy Sheet and Plate.

B. SMACNA–Architectural Sheet Metal Manual.

1.03 DESIGN REQUIREMENTS

A. Conform to SMACNA manual for sizing components for a 10-year storm event.

1.04 REGULATORY REQUIREMENTS

A. Conform to the 2002 Kentucky Building Code or governing local building code for size and method of rainwater discharge.

PART 2–PRODUCTS

2.01 GUTTERS AND DOWNSPOUTS

A. Gutters and downspouts shall be constructed of 0.050-inch-thick aluminum sheet conforming to ASTM B209 and shall be made from the same manufacturer as the fascia and soffit system.

2.02 ACCESSORIES

A. Anchorage devices shall meet SMACNA or manufacturer's requirements.

B. Gutter supports shall be straps and fasteners at minimum 3-0 on center.

C. Downspout supports shall be brackets of the appropriate size and spacing.

D. Fasteners shall be aluminum or stainless steel.

2.03 SPLASH PADS

A. Splash pads shall be precast concrete of the appropriate size with minimum 28-day compressive strength of 3,000 psi and minimum 5% air entrainment.

2.04 FABRICATION

A. Form gutters and downspouts to SMACNA requirements.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion of defects detrimental to appearance or performance. Allow for expansion by providing expansion joints as required.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.05 FINISHES

A. Finish on gutters and downspouts shall match finish on fascia system. All components, including fasteners and supports, shall be prefinished to match gutters and downspouts.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install gutters, downspouts, and accessories with manufacturer's instructions.

B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.

C. Install gutters with a 1/8-inch per foot slope.

D. Seal metal joints watertight.

E. Set splash pads under downspouts.

END OF SECTION

SECTION 07710

MANUFACTURED ROOF SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Metal fascia and soffit.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. SMACNA–Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. Submittals shall comply with requirements of Section 01300–Submittals.

B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA standard details.

1.05 WARRANTY

A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

PART 2–PRODUCTS

2.01 FASCIA

A. Metal fascia system shall be constructed of 24 gauge galvanized steel and shall include all necessary angles, clips, corners, and other accessories of the same material as the finish panels.

B. Acceptable products include the following, or equal: Fascia System by Peterson Aluminum Corporation.

2.02 SOFFIT

A. Metal soffit system shall be constructed of 0.032-inch-thick aluminum sheet and shall include all necessary channels, angles, clips, flashing, fasteners, and other accessories of the same material as the soffit panels. Soffit panels shall be perforated to allow for ventilation and shall have stiffener grooves spaced at 6 inches on center.

B. Acceptable products include the following, or equal: PAC 750 by Peterson Aluminum Corporation.

2.03 FINISHES

A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install components in accordance with the drawings and the manufacturer's instructions.

B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

SECTION 07900

CAULKING AND SEALANTS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Caulking and sealants on the project, including primers and backer rod material.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM C920–Elastomeric Joint Sealants

1.03 SUBMITTALS

A. Submittals shall comply with provisions of Section 01300–Submittals.

B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.

1.04 WARRANTY

A. Caulked joints shall be weather-tight and guaranteed watertight for five years from date of final payment. Deliver original guarantee to OWNER with copies to ENGINEER.

PART 2–PRODUCTS

2.01 CAULK–NONSUBMERGED APPLICATIONS–GENERAL

A. Caulk for nonsubmerged applications in all locations except floor joints shall be a one-part polyurethane sealant.

B. Acceptable products include the following, or equal:
   1. Sonneborn NP1 by Sonneborn–Chem Rex, Inc.
   2. Vulkem 116 by Mameco International.

2.02 CAULK–NONSUBMERGED APPLICATIONS–FLOOR JOINTS

A. Caulk for floor joints in nonsubmerged applications shall be a one-part, self-leveling, polyurethane sealant.

B. Acceptable products include the following, or equal:
   1. Sonneborn SL1 by Sonneborn–Chem Rex, Inc.
   2. Vulkem 45 by Mameco International.

2.03 ACCESSORIES

A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.

B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.

C. Cleaning fluid shall be methyl ethyl keytone (MEK), methyl tone (MIKS), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

PART 3–EXECUTION

3.01 INSTALLATION

A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weather-tight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the drawings. Caulking not specified in other sections shall be performed under this heading.

B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.

C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2 inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.

D. Backer rod shall be used in all openings 3/4-inch or more in depth and shall be tightly packed to completely fill the space to 1/2-inch back of face. The 1/2-inch shall then be filled with caulking compound.

E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.

F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a perfect appearing weather-tight condition.

END OF SECTION

SECTION 08110

STANDARD STEEL DOORS AND FRAMES

PART 1–GENERAL

1.01 SUMMARY

A. Work included: Thermally insulated and fire-rated steel doors and frames.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/SD1-100–Standard Steel Doors and Frames.

B. UL 10B–Fire Tests of Door Assemblies.

1.03 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

B. In addition to shop drawings and product data, indicate type of primer paint to be used and verify compatibility with field paint system specified.

1.04 REGULATORY REQUIREMENTS

A. Fire-Rated Door and Frame Construction: Conform to UL 10B.

PART 2–PRODUCTS

2.01 THERMALLY INSULATED DOORS

A. Thermally insulated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with polyurethane core rigid reinforcing full thickness.

B. Acceptable products include the following, or equal:
   1. Ceco Imperial.

2.02 FIRE-RATED DOORS

A. Fire-rated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with honeycomb core full thickness. Fire doors shall carry Underwriters' Label on the door.

B. Acceptable products include the following, or equal: Ceco Regent.

2.03 FABRICATION–DOORS

A. Doors shall be welded construction with all surface welds, joints, and seams filled and ground smooth.

B. Tops and bottoms of doors shall be completely closed with 16 gauge channels. No inverted channels will be allowed.

C. Mortise, reinforce, drill, and tap doors to receive hardware. Reinforcement shall be welded within the stiles and rails. Reinforce top rails to accommodate closers on either side and reinforce bottom for kickplate.

D. All Underwriters' fire doors shall be constructed to meet Underwriters' Laboratories specific approval according to current procedure for the indicated class.

E. Glass in exterior doors shall be 1-inch-thick.

2.04 FRAMES

A. Steel door frames shall be made of 14 gauge cold rolled prime quality steel in accordance with ANSI/SD1-100.

B. Fire-rated frames shall carry Underwriters' label on the frame.

C. Frames shall be removable where noted on the Door Schedule.

2.05 FABRICATION–FRAMES

A. Fabricate frames as welded unit.

B. Frames shall be 2 inches by 5 3/4 inches. Frames shall have 4-inch head member at 7-foot 0-inch doors in masonry walls.

C. Fabricate frames with hardware reinforcement plates welded in place.

D. All Underwriters' fire-rated frames shall be constructed to meet Underwriters' Laboratories specific approval according to current procedure for the indicated class.

E. Provide anchors appropriate to wall type.

F. Provide frames for all steel doors.

2.06 FINISH

A. Doors and frames shall receive one coat of rust-inhibitive, shop-applied primer paint. Primer paint must be compatible with field paint system specified.

B. Frames shall be finish painted as specified in Section 09900–Painting prior to installation. This includes back sides of door frames.

PART 3–EXECUTION

3.01 INSTALLATION–FRAMES

A. Install frames in accordance with ANSI/SD1-100.

B. Coordinate installation of frames with wall construction for anchor placement.

C. Coordinate installation of frames with installation of doors, hardware, joint sealers, and field painting.

D. Set all frames as supplied by manufacturer.

E. Frames in masonry walls shall be grouted full.

3.02 INSTALLATION–DOORS

A. Install doors in accordance with ANSI/SD1-100.

B. Coordinate installation of doors with installation of frames, hardware, glass and glazing, and field painting.

C. Set all doors as supplied by manufacturer. Hang all doors allowing for expansion and contraction at time of setting.

D. Set all hardware in accordance with templates as supplied by hardware supplier.

E. Cover all exposed hardware until completion of painting and finishing.

F. Examine hardware at completion; test, oil, grease, and adjust for perfect operation.

3.03 SCHEDULE

A. See Door Schedule on Drawings.

END OF SECTION

SECTION 08305

ACCESS DOORS

PART 1–GENERAL

1.01 SUMMARY

A. Work included: Aluminum floor doors and frame units.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 FLOOR DOORS

A. Floor doors shall be aluminum diamond pattern plate.

B. Acceptable products include the following, or equal: The Bilco Company, Type K or J as scheduled.

C. Door Type J shall be designed for a minimum live load of 300 psf with a maximum deflection of 1/150 of span. Door type K shall be designed for minimum live load of 150 psf with a maximum deflection of 1/150 of span.

D. Cover shall be 1/4-inch aluminum diamond pattern plate. Cover shall have smooth controlled operation and not be affected by temperature.

E. Type J doors, channel frame shall be 1/4-inch extruded aluminum with bend down anchor tabs. Depth of frame shall be 6 inches. A continuous EPDM gasket shall be mechanically attached to the frame around the entire perimeter.

F. Hinges shall be through bolted to the cover and frame with tamper-proof type 316 stainless steel lock bolts.

G. Provide 1 1/2-inch drain coupling located in corner of channel frame for Type J doors.

H. Type J doors shall be equipped with required number and size of compression spring operators for door to operate easily and smoothly. Provide heavy forged cam-action hinges to open door so edge of door does not open into channel. Type K doors shall have cast steel cam-action hinges which pivot on torsion bars.

I. Provide hold open arm that automatically locks in open position. Provide snap lock with fixed handle mounted to underside of cover. Provide removable exterior turn/lift handle with spring-loaded ball detent to open cover. All hardware shall be Type 316 stainless steel for corrosive environment.

2.02 FINISH

A. Aluminum floor doors shall be mill finish, with bituminous coating applied to exterior of frames.

PART 3–EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.

B. Provide piping from channel frames for Type J floor doors from outlet to base of wall nearest floor drain or through wall to ground for tank structures. Terminate pipe in minimum 1-cubic-foot of clear stone if termination is below ground.

3.02 SCHEDULE

A. See Door Schedule on the Drawings.

END OF SECTION

SECTION 08331

OVERHEAD COILING DOORS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes insulated overhead coiling door with electric operation, operating hardware, controls, and supports.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A525/A525M–Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.03 REGULATORY REQUIREMENTS

A. Conform to the 2002 Kentucky Building Code for motor and motor control requirements.

B. Products requiring electrical connection shall be listed and classified by Underwriters' Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers include the following, or equal: Overhead Door Co., Series 625 Insulated Stormtite door.

2.02 MATERIALS

A. Curtain:
   1. Curtain slats shall be Type F-265I flat crown, pitch 2 5/8-inch 0.040 inch aluminum. Back cover shall be 0.024 inch aluminum.
   2. Slat system shall be integral and foamed in place with polyurethane foam nominal 2 pound density, applied between the slat and back cover, rising to bond the slat and back cover into an integral member with a thickness of 3/4-inch.
   3. Endlocks shall be used on alternate slats. Provide windlocks as required for 25 psf design wind load.

B. Bottom Bar: The bottom bar shall be two aluminum angles, minimum thickness 1/8-inch, bolted back-to-back to reinforce the curtain in the guides, and shall have a loop-type weather seal.

C. Guides:
   1. Guides shall be three structural steel angles with a minimum thickness of 3/16-inch.

2. Guides shall be equipped with full door height PVC weather seals contacting the exterior and interior curtain surfaces to minimize air flow.
3. Guides shall be insulated full height and shall be equipped with windlock bars to meet 25 psf design wind load.

D. Brackets:
1. Brackets shall be minimum 3/16-inch-thick steel plate to support the barrel, counterbalance, and hood.
2. Provide intermediate support brackets as necessary.

E. Counterbalance:
1. Counterbalance shall be helical torsion springs housed in a steel pipe barrel, supporting the curtain with a deflection limited to 0.03 inches per foot of width.
2. Counterbalance shall be adjustable by means of an external adjusting tension wheel and designed for minimum 20,000 cycles.

F. Hood:
1. The hood shall be aluminum.
2. The hood shall have an internal baffle and an external lintel baffle to retard air infiltration.

G. Locking: Manual chain hoist operated doors shall have chain keeper locks suitable for padlocking.

H. Electric Operator:
1. Electric operator shall be Model RDB by Overhead Door Co., or equal.
2. Operator shall have a 1 hp, 460 volt, 3 phase motor.
3. Mounting shall be wall mount in location shown on Drawings. Electric panel shall be mounted separately.
4. Operator shall have a brake that shall be spring-set and solenoid released and be able to stop and hold curtain in any position.
5. Provide push button control (open/close/stop) in NEMA 4X station.
6. Provide electric sensing edge to stop and reverse door upon contacting an object. Electric sensing edge shall be powered from the electric operator.

2.03 FINISHES

A. Aluminum curtain and hood shall receive a clear anodized finish.

B. All nongalvanized, exposed, ferrous surfaces shall receive one coat of manufacturer's standard factory-applied rust-inhibitive primer compatible with field paint.

PART 3–EXECUTION

3.01 INSTALLATION

A. Door shall be installed in accordance with manufacturer's instructions and standards by an authorized representative.

B. Upon completion of installation, operating devices and controls shall be adjusted and lubricated to operate properly.

3.02 SCHEDULE

A. See Door Schedule on the Drawings.

END OF SECTION

SECTION 08520

ALUMINUM WINDOWS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes interior extruded aluminum window frames.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. AAMA 101–Specifications for Aluminum Prime Windows and Sliding Glass Doors.

B. ASTM E283–Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.

C. ASTM E330–Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

D. ASTM E331–Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

E. ASTM B221–Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

F. AAMA 608.1–Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

1.03 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand a design pressure of 60 psf for interior windows in accordance with ASTM E330.

B. Limit member deflection to 1/175 with full recovery of glazing materials.

C. System to accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.

D. Limit air leakage through assembly to 0.10 cfm/min/sq ft of wall area measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E283.

E. Water leakage: None when measured in accordance with ASTM E331 with a test pressure difference of 10 psf.

1.04 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 INTERIOR WINDOWS

A. Interior window frames shall be 2-inch-deep extruded aluminum in accordance with ASTM B221.

B. Acceptable products include the following, or equal: Kawneer Sealair 7200 Series.

2.02 FABRICATION

A. Aluminum extrusions shall be not less than 0.125-inch-thick.

B. All fabrication and erection fasteners shall be 18-8 stainless steel.

C. Nominal window height and length for all windows shall be as shown in the schedule. CONTRACTOR shall measure all openings and coordinate sizes with window supplier.

2.03 FINISH

A. Finish on all exposed aluminum shall be architectural class 1, anodic coating, confirming to AAMA 608.1 Color to be selected by OWNER.

PART 3–EXECUTION

3.01 INSTALLATION

A. Field verify wall opening sizes.

B. Frames shall be securely attached to masonry as recommended by the window manufacturer.

3.02 SCHEDULE

A. See window location on the Drawings.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hardware to fully equip all doors.
   2. Thresholds and weatherstripping.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NFPA 80–Fire Doors and Windows.

1.03 REGULATORY REQUIREMENTS

A. Hardware shall conform to the 2002 Kentucky Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.

B. Hardware shall comply with barrier-free requirements.

PART 2–PRODUCTS

2.01 LOCKS AND LATCHES

A. Locks, latches, and dead locks shall be Sargent cylindrical key-in-lever locks Series 10L, or equal, with 2 3/4-inch backset. Strikes shall be curved lip. Lockset and latchset numbers specified in paragraph 3.02 are Sargent. Provide removable core brass 6- or 7-pin cylinders.

2.02 EXIT DEVICES

A. Exit devices shall be Sargent 8813 x ETL Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. The exit device shall be operated by a lockable lever from the exterior side.

2.03 HINGES

A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonremovable, flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch butts per door for doors 7 feet or less in height with one additional butt for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional butt or heavy-weight hinges for all doors that are over 36 inches wide, unless specified otherwise. Finish on aluminum entrance doors shall match framing.

2.04 CLOSERS

A. Door closers shall be LCN Series 1460 for exterior doors and 1461 for interior doors, or equal. Provide aluminum finish on closers. Provide full covers. Door closers for locations noted as (ss) shall have the SRI primer for corrosion resistance. Door closers specified in paragraph 3.02 are LCN. (H-Hold Open)

2.05 OVERHEAD HOLDERS

A. Door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Holders for locations noted as (ss) shall be fabricated with stainless steel components. Numbers specified in paragraph 3.02 are Glynn Johnson.

2.06 SURFACE BOLTS

A. Surface bolts shall be 8-inch Ives 1630 series, or equal. At doors with (ss) hardware, bolts shall be 8-inch Ives 1640 Series, or equal.

2.07 KICKPLATES

A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

2.08 DOOR STOPS

A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, GJ60W for locations noted as (ss), or equal.

2.09 THRESHOLD AND WEATHERSTRIPPING

A. All exterior doors shall be weatherstripped with Reese DS106, National Guard Products, Inc. 190, or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S104A, Pemko 175A, or equal, thresholds. Exterior doors without mullion shall have Reese No. 87, Pemko 352A, or equal, positive sealing astragal.

2.10 PUSH/PULL BARS

A. Push bar shall be Rockwood 47; door pull shall be Rockwood 111 x 10-inch CTC.

2.11 PUSH PLATE AND PULL

A. Push plate shall be Rockwood No. 70C 4-inch by 16-inch with 111x70C pull manufactured by Rockwood.

2.12 KEYING

A. Door keys shall be keyed alike. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

2.13 FINISH

A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified in paragraph 2.

B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.

C. Where stainless steel (ss) is specified, all hardware, including threshold and weather stripping, shall be installed with stainless steel fasteners.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide finish hardware to fully equip all doors.

B. Install hardware in accordance with manufacturer's instructions.

3.02 SCHEDULE

A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

Group 1 — EXTERIOR DOOR

Lockset–10G05
Door Closer–1460H (Parallel Arm)
Butts & Kickplate

Group 2 — INTERIOR DOOR

Latchset 10U15
Door Closer–1461 BF (Regular Arm)
Butts & Kickplate

END OF SECTION

SECTION 08800

GLAZING

PART 1–GENERAL

1.01 SUMMARY

A. Work includes glass and glazing for windows.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. FGMA–Flat Glass Marketing Association, "Glazing Manual."

1.03 WARRANTY

A. Coated glass shall be provided with a 10-year warranty against peeling, cracking, or deterioration of the coating.

PART 2–PRODUCTS

2.01 INTERIOR GLASS

A. Glass in interior windows and interior door lights, except as noted, shall be 1/4-inch-thick float glass, fully tempered.

B. Acceptable manufacturers include the following, or equal: Interpane Glass Company.

2.02 GLAZING COMPOUNDS AND ACCESSORIES

A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.

B. Acceptable products include the following, or equal:
1. Tremco Vision Strip System.
2. General Electric Silglaze.

2.03 FABRICATION

A. Glazing of windows shall be from the interior.

B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.

C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

PART 3–EXECUTION

3.01 INSTALLATION

A. Comply with "Glazing Manual" by Flat Glass Marketing Association (FGMA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.

B. Completed installation shall be water- and airtight.

END OF SECTION

SECTION 09520

ACOUSTIC PANELS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Perforated metal acoustical wall panels.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A84–Flame Spread.

B. ASTM C423-NRC.

1.03 REGULATORY AND PERFORMANCE REQUIREMENTS

A. All products furnished shall have a flame spread classification of 0-25 for a Class A or Class 1 rating in accordance with ASTM E84.

B. All products furnished shall be tested in accordance with ASTM C-423-90 for Sound Absorption.
   1. Test results for a Type A mounting method shall yield an NRC (Noise Reduction Coefficient) of no less than 1.0.
   2. Test results for a Type D-100 mounting method shall yield an NRC (Noise Reduction Coefficient) of no less than 1.15.

1.04 SUBMITTALS

A. Manufacturer's Literature and Data: Submit manufacturer's technical data and brochures specified system.

B. Shop Drawings: Show dimensions, sizes, thickness, finishes, joining, mounting attachments, and relationship to adjoining work.

C. Samples: Include a minimum 12-inch by 12-inch nominal piece of each type of metal, finished as specified, and accessories.

D. Maintenance Data: Provide maintenance instructions for acoustical panels to be included in maintenance manuals as specified in Division 1.

1.05 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be protected during fabrication, shipment, site storage and erection to prevent damage to the finished work from other trades. Store acoustical panels inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include the following or equal: ALPRO® Acoustical Systems, Division of Gordon, Inc.

2.02 MATERIALS

A. The acoustical panels shall be ALPRO® pattern E, or equal.

B. Panels shall be fabricated of 0.032-inch-thick aluminum with smooth finish.

C. Panels shall be perforated using 1/8-inch-diameter holes on 21/64-inch staggered centers, providing a 13% open area.

D. Acoustical insulation shall be 2-inch-thick PVC encapsulated fiberglass.

E. Wall Panel Mounting and Accessories: Provide Z-furring, J Trim and inside/outside corner angles in a size and length to completely support and finish trim the wall panels. All mounting accessories shall be finished to match wall panels.

2.03 FINISHES

A. Powder Coat Finish (Interior Use Only): All panels and accessories shall receive a micro-etched pretreatment prior to receiving an electrostatically applied powder coat paint finish.

B. All cut edges, including perforated holes must be coated. Finish shall be cured and oven baked to ensure paint adhesion and uniform surface hardness.

C. Paint color to be selected by OWNER from manufacturer's standard colors.

PART 3–EXECUTION

3.01 INSTALLATION

A. Wall panel systems shall be installed in accordance with manufacturer's recommendations.

B. Tolerances:
   1. Install wall panel system with a maximum surface deviation of 1/8 inch in 4 foot 0 inch (no load applied) per ASTM 635-92.

3.02 SCHEDULE

A. Install panels as indicated on the Drawings.

END OF SECTION

SECTION 09900

PAINTING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Surface preparation and application of paints and coatings.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM D4060–Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

B. ASTM D4541–Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

C. ASTM D3363–Test Method for Film Hardness by Pencil Test.

D. ASTM D2247–Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

E. ASTM D4585–Practice for Testing Water Resistance of Coatings Using Controlled Condensation.

F. ASTM B117–Test Method of Salt Spray (Fog) Testing.

G. SSPC–The Society for Protective Coatings–Steel Structures Painting Manual.

H. Federal Register–Code of Federal Regulations (CFR).

I. Federal Register–Resource Conservation and Recovery Act (RCRA).

J. Federal Register–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.03 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.

C. Submit two copies of manufacturer's Material Safety Data Sheets (MSDS) for each type of paint with each shop drawing submittal. MSDS sheets shall be posted at the construction site at all times painting is in progress.

D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in paragraph 2.01.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
   2. All paints shall be NSF Standard 61-approved when they are in contact with potable water or within potable water reservoirs.

B. Prepainting Meeting:
   1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
   2. CONTRACTOR, the paint Subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
   3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.

B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.

C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

1.06 ENVIRONMENTAL REQUIREMENTS

A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.

B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open flame heaters shall not be used.

C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

1.07 EXTRA MATERIALS

A. Provide one gallon of each component of paint/coating. Label with color, type, and room location.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin Williams Company, or equal, unless noted otherwise in the schedule.

B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.

C. Paint and paint products of Tnemec Company and Sherwin Williams, listed in the following specifications, are set up as standard of quality. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM specifications shall be the latest revision.
   1. Abrasion–ASTM D4060, CS-17 Wheel, 1,000 grams load.
   2. Adhesion–ASTM D4541.
   3. Hardness–ASTM D3363.
   4. Humidity–ASTM D2247 and D4585.
   5. Salt (Fog) Spray–ASTM B117.

PART 3–EXECUTION

3.01 SURFACE PREPARATION

A. General:
   1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
   2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive blast cleaned and repainted.
   3. Prior to field blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
   4. For on-site abrasive blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
   5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.

B. Ferrous Metal:
   1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
   2. All ferrous metals not primed in the shop shall be abrasive blasted in the field prior to application of the primer, pretreatment, or paint.

3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per NAPF 500C.

C. Concrete:
1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive blast cleaned in accordance with ASTM D4259 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a texture similar to 40-60 grit sandpaper (ICRI SP3-5). Bug-holes that are opened up shall be filled with an appropriate filler.
3. Bug-holes shall be filled as specified in Section 03300--Cast-in-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.

D. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with non-hydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC SP 1 and shall be abrasive blasted in accordance with SSPC-SP7.

E. Copper: Where copper piping is not submerged or buried, it shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

F. PVC and CPVC: All PVC and CPVC to be painted shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

G. Aluminum: Where listed in the Schedule to be painted, it shall be solvent cleaned in accordance with SSPC SP 1 and shall be lightly sanded.

H. Wood:
1. Wood surfaces shall be thoroughly cleaned and free of all foreign matter. Cracks and nail holes and other defects shall be properly filled and smoothed.
2. Wood trim shall be sandpapered to a fine finish and wiped clean of dust.

3.02 APPLICATION

A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.

B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.

C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.

D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.

E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.

F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.

G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.

H. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to: between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.

I. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07900 requirements, except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting.

J. For PVC and CPVC piping, unions and valves shall not be painted.

3.03 FIELD QUALITY CONTROL

A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

3.04 CLEANING

A. All stains and marks shall be removed from other surfaces upon completion of the work.

3.05 SCHEDULE

A. General:
   1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched up.
   2. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze or brass, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.
   3. Products listed first are Tnemec and second are Sherwin Williams.

B. New Work:
   1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all ferrous metal items

scheduled for painting be shop primed. If items are not shop coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.

2. Interior Concrete Floors:

   One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%,
   hand broadcast anti-skid sand into the wet paint during application in locations as requested by OWNER; and

   One coat of N69 Hi-Build Epoxoline II, Macropoxy 646.

3. Interior Concrete Block Walls:

   Three coats of N69 Hi-Build Epoxoline II, Macropoxy 646.
   If lightweight concrete block is used, four coats as specified, minimum, shall be applied.

   Note: Paint shall be roller- or brush-applied to concrete sound absorptive block.

4. Interior Concrete Walls, Including Equipment Bases:

   One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%; and
   One coat of N69 Hi-Build Epoxoline, Macropoxy 646.

   Note: Interior face of concrete tank walls and floors, channels, and pipe trenches are not to be painted.

5. All Exposed Concrete Ceilings (ceilings of water-containing tanks are not considered exposed):

   One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, thinned 10%; and
   One coat of N69 Hi-Build Epoxoline, Macropoxy 646.

6. Cast or Ductile Iron; Not Submerged or Buried:

   One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
   Touch up prime coat prior to finish coating; and apply either:

   Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or

   One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and
   One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

7. Cast or Ductile Iron, Tar Coated; Buried:

   Not painted

8. Cast or Ductile Iron; Submerged:

   One shop coat of 140-1255 Beige Pota-Pox Plus, Macropoxy 646 NSF Beige as primer;
   Touch up prime coat prior to finish coating; and
   One coat of 140-AA83 White Pota-Pox Plus, Macropoxy 646 NSF White; and

One coat of 140-AA90 Pota-Pox Plus, Macropoxy 646 NSF.

9. Steel, Machinery, and Equipment; not Submerged:

   One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer; Touch-up primer prior to finish coat; and either

   Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or

   One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and
   One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

   First field coat shall be applied prior to installation to surfaces inaccessible after installation, including back sides of door frames. See Division 8 for factory applied door primers.

10. Motors, gear drives, and doors delivered with non-epoxy primers:

    Degrease per SSPC-SP1.
    Lightly hand-sand per SSPC-SP2.
    Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Beige.
    Apply two finish coats as follows:

    Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or

    One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and
    One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

11. Steel, Machinery, and Equipment; Submerged:

    For Areas in Contact with Potable Water:

    One shop coat of 140-1255 Beige Pota-Pox Plus, Macropoxy 646 NSF Beige as primer; and
    Touch up prime coat prior to finish coating; and
    One coat of 140-AA83 Pota-Pox Plus, Macropoxy 646 NSF White; and
    One coat of 140-AA90 Pota-Pox Plus, Macropoxy 646 NSF.

12. Galvanized, Copper, CPVC, and PVC; not Submerged or Buried:

    One coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646; and either

    Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 for interior surfaces; or

    One coat of N69 Hi-Build Epoxoline, Macropoxy 646; and
    One coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

13. Insulation of Equipment, Pipes, and Ductwork:

    Two coats of Series 6 Tnemec-Cryl, DTM Acrylic B66W1.

14. Galvanized, Copper, CPVC, and PVC; Submerged or Buried:

    Not painted

15. Aluminum Items:

    Exposed areas of structural items such as railings and grating shall not be painted.

    For structural items in contact with concrete; See Division 5.

16. Stainless Steel:

    Not painted

C. Coverage:

1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT thickness as specified and recommended by the manufacturer.

	Sq. Ft.** Coverage	Dry Mil Thickness Per Coat
Products		
6 Tnemec-Cryl, DTM Acrylic B66W1	200	
N69 Hi-Build Epoxoline II, Macropoxy 646		
Concrete Block Primer Coat	90	---
Concrete Block Intermediate Coat(s)	130	---
Concrete Block Finish Coat	140	---
Concrete Primer Coat	100	---
Concrete Intermediate Coat(s)	140	---
Concrete Finish Coat	160	---
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646	335	4.0
Steel Doors	---	3.0
140 Pota-Pox Plus, Macropoxy 646 NSF		
Steel or Impervious Substrate Primer	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish Coat	---	5.0
1074 Endura-Shield II	---	2.5
Sherwin-Williams Product		
ProMar 200 primer (sprayed)	200	
ProMar200 Primer (rolled/brushed)	260	
ProMar 200 Enamel (sprayed)	280	

	Sq. Ft.** Coverage	Dry Mil Thickness Per Coat
ProMar 200 Enamel (rolled/brushed)	360	
A 100 Alkyd Wood Primer (sprayed)	200	
A 100 Alkyd Wood Primer (rolled/ brushed)	260	
A 100 Satin Latex Trim (sprayed)	280	
A 100 Satin Latex Trim (rolled/ brushed)	360	
S-W Wood Classics Stain (sprayed)	390	
S-W Wood Classics Stain (rolled/brushed)	480	
S.W. Wood Classics Varnish (sprayed)	320	
S.W. Wood Classics Varnish (rolled/brushed)	360	

** Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final total dry film thickness (DFT) shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to assure coverage.

D. Colors:
   1. Colors are to be selected by OWNER, with the following piping colors used where applicable:

E. Labels: In addition to the color code, each pipe shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Labels shall be abbreviated as noted under fluid abbreviations on the drawings. Labels shall be painted with stencils, 2-inch letters on pipes 4 inches and larger and 1-inch letters on pipes smaller than 4 inches. Labels shall include arrows indicating direction of flow. Snap-on pipe markers with permanent tension built into each plastic marker to grip pipe firmly may be used instead of painted labels. Snap-on labels shall be Brady, System 3, or equal mechanically affixed pipe markers.

F. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase. Color coding shall also be used.

G. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch up any damaged areas with factory provided touch up coating.
   1. Sectional overhead doors and overhead coiling doors.
   2. Aluminum windows, doors and entrances.
   3. Hoists, trolleys, and cranes.
   4. Factory finished HVAC equipment.
   5. Motor Control Centers.
   6. Supervisory Control Centers.
   7. Switchgear.
   8. 4KV standby Power System.
   9. Sump pumps.

END OF SECTION

SECTION 10441

PLASTIC AND METAL SIGNS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Room signs.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, and overall dimensions of each sign.

PART 2–PRODUCTS

2.01 ROOM SIGNS

A. Provide room signs, W.H. Brady Co., B-909, or equal. OWNER shall select color.

B. Sign shall also incorporate handicap accessible symbol.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install signs after surfaces are finished in locations as directed.

END OF SECTION

SECTION 10520

FIRST AID KIT

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: First aid kit.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MANUFACTURER

A. First aid kit shall be Johnson and Johnson Model No. 3114-2 wall-mounted (50-person 225-item kit), Lab Safety Supply Co. (800-356-0783), or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. First aid kit shall be wall-mounted.

B. Mount where requested by OWNER.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1--GENERAL

1.01 SUMMARY

A. Work Included:
   1. Fire extinguishers.
   2. Accessories.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NFPA 10–Portable Fire Extinguishers.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

1.04 QUALITY ASSURANCE

A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.

B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

PART 2--PRODUCTS

2.01 MANUFACTURERS

A. Larsen's Manufacturing Company, Product MP Series.

B. Substitutions: Under provisions of Section 01600–Materials and Equipment.

2.02 EXTINGUISHERS

A. Provide six dry chemical-type, Larsen's MP Series, 10-pound capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B and Class C fires.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place extinguishers in brackets where shown on the Drawings.

C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.

END OF SECTION

SECTION 11216

TURBINE PUMP

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. This section includes furnishing, installing, and placing into successful operation three turbine pumps of the line shaft-type complete with pump bowl assembly, column and shaft assembly, head assembly, can enclosure, and electric motor.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Project Data/Bid Requirements:
   1. Bidder shall furnish with its Bid performance data and curves showing pump field delivery when driven by motor.
   2. Bidder shall furnish the following information in duplicate:
      a. Name of pump manufacturer and type of model designation.
      b. Field operating speed of unit. All performance data and tests shall be at this speed.
      c. Number and size of bowls.
      d. NPSH required for lowest stage.
      e. Column and coupling o.d.
      f. Column shaft size, material, and rated permissible horsepower per AWWA E101.
      g. Name of motor manufacturer and type or model designation of motor with full information on frame size, insulation, and temperature rating.
      h. Motor rated horsepower without service factor.
      i. Motor service factor.
      j. Full load and locked rotor motor current.
      k. Motor efficiency at half, three-quarters, and full load.
      l. Maximum load on motor thrust bearing and 5-year life rated load.
      m. Complete performance curves drawn for the equipment being offered (not a page from a catalog) showing field capacity-head from shutoff to cutoff, NPSH required, wire to water efficiency, and brake horsepower from shutoff to zero head.
      n. Full descriptive literature on type of pump offered including a list of five similar installations where proposed unit has been in operation for a period of not less than 5 years.
   3. The above specifications and data, as approved by ENGINEER, shall become a part of the Contract, and the equipment shall be constructed and installed in accordance with them.

B. Shop Drawings: Shop drawings showing complete base assembly and casing position shall be submitted to ENGINEER for review and approval.

C. Factory Test Submittals:
   1. All pumps shall be factory tested in accordance with AWWA E101 standard running test and discharge head hydrostatic test requirements plus the requirements of these specifications. Tests shall be made with the field motor.
   2. Test points shall include shutoff head, rated head, plus at least three other points as required for accurate curve plotting. Test data shall be obtained and computations made so that field head-discharge curves, field wire to water efficiency curve, and field power consumption in kwh per 1,000 gallons at the performance point are submitted to ENGINEER.
   3. Pump heads shall not include velocity head or internal pump friction heads, and these heads shall not be included in performance curves. Test results shall be corrected to show field performance at the speed at which the unit will operate with 4160 volts at the motor terminals.
   4. ENGINEER shall be furnished three certified copies of all test data, calculations showing losses not included in the shop tests, field performance curves, and computations and curves showing field power consumption by the motor and bhp load on the motor.
   5. Shipment shall not be made until ENGINEER approves the factory test data.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Electrical equipment shall conform to the standards of the AIEE, NEMA, and the NEC. Except as otherwise specified, the units shall conform to AWWA E101 and the requirements of the Kentucky Building Code.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Type of pump, efficiency, and head-discharge curve slope required to be similar to Flowserve, or equal.

2.02 EQUIPMENT

A. Design Requirements:
   1. Pump heads as specified herein are field heads external to the pumping unit; they do not include velocity head or internal friction head, and these heads shall not be included in pump test head or pump performance data. Pump discharge head is that shown by a piezometer tap at the pump discharge.
   2. To convert pump bowl assembly heads or shop heads and shop test motor loads to field heads and field driver loads, hydraulic and mechanical friction loads as shown in AWWA E101 shall be used.
   3. A steep head discharge curve at performance point maintaining high efficiency each side of the performance point is desired, and this characteristic will be considered in awarding the Contract.

B. Performance Requirements:
   1. Under normal operating conditions, the pump shall have a minimum performance point capacity of 6944 gpm against a total head exterior to the pump of 468 feet while at 1185 rpm nominal speed.
   2. Bowl efficiency shall be a minimum of 85.7 at the operating point.

2.03 COMPONENTS

A. Bowls:
   1. The pump bowls are to be cast iron.
   2. Replaceable bowl wearing rings shall be provided.
   3. The bowls shall be no larger than nominal {_____}-inch-diameter.

B. Impellers:
   1. The impellers are to be bronze or enameled cast iron.
   2. The impellers shall be fully enclosed.
   3. Impellers selection shall meet NPSH requirements with pumping level at the top of the bowl assembly.

C. The impeller shaft shall be Type 410 stainless steel with bronze bearings in each bowl.

D. Suction and discharge nozzles shall be used below and above the bowl assembly with straightening vanes and long bearings for the pump shaft.

E. Column:
   1. The pump column shall be 18-inch nominal diameter, standard weight steel, and threaded and coupled in maximum ten-foot lengths.
   2. Column ends shall be finished so that spiders and bearing retainers are tightly and firmly held in place.
   3. Column shall be unpainted and completely cleaned of all coatings prior to installation.

F. Line Shaft:
   1. The line shaft shall be turned and polished 416 stainless steel and shall have stainless steel or monel sleeves through the shaft bearings with threaded couplings to develop the full strength of the shaft.
   2. The top shaft shall be two-piece.
   3. The shaft shall be at least 2.44-inch-diameter.

G. Line Shaft Bearings:
   1. Line shaft bearings shall be rubber, designed for water lubrication, have fluted bearing surface, firmly fixed in the bearing retainer, and shall not rotate in the retainer. Bearings relying only on an adhesive substance to hold the bearings in place will not be accepted. The rubber bearing shall be standard stock size requiring no sleeve, adapter, or modification to fit in the retainer.
   2. Bearing alignment spiders shall be steel cast iron, ASTM A48, Class 30 bronze ASTM B584 Alloy 835 or Alloy 844.
   3. The Bidder shall have bearings as proposed in satisfactory operation on similar pumps for at least 5 years.

H. Discharge Head:
   1. The discharge head shall be cast iron, minimum 250 psi rating. Discharge head shall be capable of withstanding pump shutoff pressure, plus 100 psi surge allowance.
   2. The outlet of the pump is to be equipped with a flange, faced and drilled to 20-inch-diameter, 250-pound standard. The outlet is to be above floor level and shall be smoothly finished to conform in appearance to motor finish.
   3. The base shall have a raised lip to collect gland leakage and shall have a 20-inch outlet for connection to drainage piping.
   4. The head shall be built for water lubricated line shaft.

5. The discharge head shall have a shop prime coat as specified in Division 9 of these specifications.
6. The discharge head at point of attachment to the motor shall be at least as large in diameter as the motor base, so that the motor does not overhang.

I. Miscellaneous Tubing:
1. All miscellaneous tubing required in or on the pump for bearing cooling, drainage, lubrication, etc., shall be furnished and placed by the Pump Contractor. Tubing shall be brass or hard copper with sweated fittings. Unions shall be provided for dismantling.
2. Insofar as practicable, all such piping and tubing is to be installed inside the pump head frame and must be installed in a workmanlike manner.

J. Subbase:
1. There shall be provided a separate detachable subbase to be permanently grouted into the concrete pump base. The discharge head shall be bolted to the subbase.
2. Anchor bolts shall have 3-inch-square by 3/8-inch plate and nut at lower end.
3. All anchor bolts, sleeves, and adapter (if necessary) for the top of the well casing to permit proper pump and piping installation shall be furnished and placed by CONTRACTOR.

K. Motor:
1. The motor shall be vertical, hollow shaft, squirrel cage induction-type, drip-proof, ball bearing, maximum 1,200 rpm, 105°C rise above 40°C ambient on continuous operation, NEMA Design B, NEMA Class F insulation with a Class B insulation rise built for variable speed operation.
2. It shall be built for operation on 4,160 volt, three phase, 60 cycle current, with allowance for ±10% voltage variation and shall be so labeled.
3. The motor shall have a 1.15 service factor, shall not be loaded beyond nominal rating (not including service factor) at any head on the pump, and shall be at least 1,000 hp.
4. The motor thrust bearing shall be rated for use with the motor and pump supplied. Minimum rated bearing life shall be 5 years. Nameplate data shall identify the bearing and the type and weight of lubricant required. Bearing shall be proper for use with motor and pump setting as described under line shaft.
5. A nonreverse ratchet shall be included.
6. The motor shall have a shop prime coat as specified in Division 9 of these specifications.
7. Motors shall be provided with thermal sensors applied to the motor windings to shut down the motor in the event of overtemperature. Manual reset at the VFD or starter shall be required to restart motor. Motors shall have copper windings and ball or roller bearings in end brackets of steel or cast iron or aluminum brackets with steel bearing sleeves. Motor shall be variable torque inverter duty rated meeting the requirements of NEMA MG1, Part 31 and be capable of operating with a minimum turndown of 4:1.
8. Motors shall be premium efficient per NEMA MG-1.

L. Pump Can:
1. The booster pump can shall have an exposed suction with minimum dimensions as noted on the drawings.
2. Pump can shall be designed to withstand a working pressure of 150 psi plus a 100 psi surge pressure, made of AWWA C200 pipe, minimum 3/8-inch walls.
3. Both interior and exterior surfaces of the barrel shall be shop-sandblasted to meet structural steel painting Specification No. 6–Commercial Blast and painted.

4. CONTRACTOR shall pressure test the pump can along with the suction and discharge piping.

2.04 FINISHES

A. Motor shall be factory-primed and finished painted using the manufacturer's standard paint system for the specified application.

B. It is the intent of this specification that the discharge head, and motor shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be 140-1255 Beige Pota-Pox Primer and shall be NSF-approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

C. Pump bowls and column shall be brush-sandblasted prior to installation to remove all coatings.

PART 3–EXECUTION

3.01 INSTALLATION

A. CONTRACTOR shall pour the concrete pump base to the elevation required for the pump.

B. The top of the first pour will be left rough for proper bonding of the final pour.

C. The pump metal subbase shall be bolted to the pump base before placing the assembly on the concrete base. The metal pump base shall have a running thread bolt at each corner which will bear on the top of the rough concrete and carry the load of the pump. The running thread bolt shall have a locking nut above and below the metal pump base and a nut at its lower end with 3-inch-square by 3/8-inch plate. The pump base shall be properly adjusted by means of the running thread bolts until the motor shaft is properly centered in the hollow shaft motor.

D. CONTRACTOR will then complete the concrete base and grout the entire base assembly in place so that the subbase is a permanent part of the concrete curb.

E. Both casings shall project 1 inch above the top of the concrete base.

F. As the pump is being installed, it shall be washed inside and out with water containing 200 ppm of available chlorine per AWWA C654. All surfaces shall be wetted with the chlorine solution. CONTRACTOR shall sample for bacteria twice at least 8 hours apart. Results shall be reported to OWNER. If either sample is determined to be unsafe,

CONTRACTOR shall rechlorinate per AWWA C654 and resample until two consecutive safe samples are obtained.

G. The terminal box shall be located as requested by ENGINEER. Provide an oversized terminal box to accommodate shielded cable terminations.

3.02 FIELD QUALITY CONTROL

A. Site Tests: Vibration:
   1. Vibration at any point on the equipment and shafting as operated in the field in excess of 4.0 mils shall be the cause for rejection. All surfaces intended for bearing shall be in full contact, and insertion of washers or spacers to minimize vibration will not be permitted.
   2. OWNER will make field and power tests to check compliance with the specifications.

B. Penalties:
   1. If the unit after installation does not operate smoothly, does not meet the vibration limitations, or does not operate in accordance with the factory characteristics curve, it shall be adjusted until it meets these standards, or it shall be removed by CONTRACTOR. OWNER retains the right to assess a 5-year power consumption penalty if the pump does not operate according to the factory test power consumption curve once the pump is installed in the field.

END OF SECTION

SECTION 13200

PRESTRESSED CONCRETE STORAGE TANK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Provide all materials, equipment, tools, and labor necessary for the designing, manufacturing, erection, disinfection, and testing of a 3,000,000-gallon, wire-wound, prestressed, concrete circular water tank, with steel diaphragm complete, including all site work, excavation, reinforcing, concrete, foundations, appurtenances disinfection, testing, and backfill directly related to the tank, as shown on Drawings.

B. Alternatives:
   1. Alternative Bids will be accepted for a steel tank and glass lined tank. Except as noted, all specification sections apply to all tanks.

C. Payment Procedures:
   1. Any rock excavation, if encountered, shall be included in the Lump Sum Bid.
   2. All excavation shall be included in the Lump Sum Bid.
   3. Tests for soundness of rock as described under Paragraph 3.01 C shall be conducted by geotechnical engineer, and costs for tests shall be reimbursed by OWNER.
   4. All lean mix concrete required on top of sound bedrock to bring the bearing surface to the elevation of the bottom of exterior tank wall foundations and interior floor slab shall be included in the Lump Sum Bid.
   5. The costs for all concrete tests and disinfection shall be included in the Lump Sum Bid.

1.02 REFERENCES–Latest editions of each reference at the time of bidding shall apply.

A. American Concrete Institute (ACI) 301–Specifications for Structural Concrete for Buildings.

B. ACI 318–Building Code Requirements for Reinforced Concrete.

C. American Society for Testing and Materials (ASTM) B117–Practice for Operating Salt Spray (FOG) Apparatus.

D. ASTM D1186–Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coating Applied to a Ferrous Base.

E. ASTM D2247–Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

F. ASTM D3363–Test Method for Film Hardness by Pencil Test.

G. ASTM D4060–Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

H. ASTM D4214–Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.

I. ASTM D4417–Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.

J. ASTM D4541–Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

K. ASTM D4585–Practice for Testing Water Resistance of Coatings Using Controlled Condensation.

L. ASTM D5064–Practice for Conducting a Patch Test to Assess Coating Compatibility.

M. AWWA–Standard C652–Disinfection of Water Works Storage Facilities.

N. ACI 372R-03-Design and Construction of Circular Wire and Strand-Wrapped Prestressed Concrete Structures.

O. AWWA D110-04-Wire and Strand-Wound, Circular, Prestressed Concrete Water Tanks.

P. NAPF–National Association of Pipe Fabricators 500-03–Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.

Q. NSF–NSF International Standard 61–Drinking Water Components.

R. SSPC–Society for Protective Coatings–Steel Structures Painting Manual.

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall have a minimum of 5 years experience of the tank fabrication and erection, with a minimum of 10 tanks constructed of each type proposed.

B. Regulating Requirements: The materials, design, fabrication, and erection of the tank and its foundation shall conform to the current:
   1. AWWA D110-American National Standards for Wire-and Strand-Wound, Circular, Prestressed Concrete Water Tanks.
   2. Tank and appurtenances shall meet all local code requirements.
   3. The design of the tank and foundation shall conform to the requirements of the Kentucky Building Code for seismic conditions and design loads and shall be performed under direct supervision of a Professional Engineer experienced in the design of this Work and licensed in the State of Kentucky.

1.04 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

B. Submit four copies of manufacturer's Operation and Maintenance Manuals in accordance with Division 1 requirements.

C. Shop Drawings: Provide complete plan, elevation, and sectional views showing critical dimensions including:
   1. Size, location, and number of all reinforcing bars.
   2. Thickness of all parts of the tank structure including floor, core wall, dome, and covercoat.

3. Prestressing schedule including number and placement of prestressing wires on the tank wall and total applied force per foot of wall height.
4. Location and details of all accessories required.
5. Minimum size of shop drawings shall be 18 inch by 24 inch.

G. Product Data: Submit concrete design mixes including ingredient proportions, minimum cementitious content, and water/cement ratio in accordance with these specifications.

H. Design Data: Submit structural calculations for the tank and concrete foundations, signed and sealed by a Professional Engineer experienced in the design of this Work and licensed in the State of Kentucky.

I. Test Reports: Submit concrete strength reports for 7-day and 28-day breaks.

J. Warranty Document: Submit warranty document in OWNER's name.

K. Project Record Documents: Record actual location layout and final configuration of tank and accessories on shop drawings and submit to engineer after construction of the tank is complete.

1.05 WARRANTY

A. Provide warranty for workmanship and materials on the complete structural portion of the tank, including accessories, for a five-year period from date of acceptance of the work. Damp spots on the exterior wall surface or measurable leakage of water at the wall base shall not be permitted. In case leakage, damp spots, or other defects appear within the five-year period, the tank manufacturer shall promptly repair the tank at its own expense upon written notice by the OWNER that such defects have been found. Leakage is defined as a stream flow of liquid appearing on the exterior of the tank, the source of which is from the inside of the tank. Damp spots are defined as spots where moisture can be picked up on a dry hand.

1.06 SITE CONDITIONS

A. Existing Conditions:
1. Soil borings were made, and the logs are shown in the Appendix of these specifications. The information on the borings is not guaranteed and does not eliminate CONTRACTOR's responsibility to make his own investigations.
2. The complete soil report is available for review at Strand Associates, Inc., 325 W. Main Street, Suite 710, Louisville, KY 40202.
3. Exterior tank foundations shall bear on the higher quality rock found in the lower (Millersburg Member) rock layer as recommended in the project soils report. Substantial rock excavation is anticipated. The foundation excavation shall be backfilled with lean concrete or flowable fill to the foundation bearing elevation as determined by the manufacturer's design. The tank interior floor slab shall bear on solid rock. Rock excavation is anticipated. The floor slab excavation shall be backfilled with lean concrete or flowable fill to the floor slab bearing elevation as determined by the manufacturer's design.

1.07 FAA DETERMINATION

A. The height and location of the elevated tank does not exceed the requirements to submit an application to the FAA as outlined in the FAA application form. An FAA determination is not required for this tank.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. The Crom Corporation, Gainesville, Florida, or equal, is the acceptable tank construction company.

2.02 PERFORMANCE

A. The design shall be in conformance with applicable portions of American Concrete Institute (ACI) 372R-03 Design and Construction of Circular Wire and Strand-Wrapped Prestressed Concrete Structures, AWWA D110-04 Wire and Strand-Wound, Circular, Prestressed Concrete Water Tanks, and currently accepted engineering principles and practices for the design of such facilities.

B. Capacity: 3 million gallons.

C. Dimensions: 113 ft inside diameter, 40 ft sidewall depth.

D. Roof and Wall Design Loads: Consideration shall be given to all applicable roof and wall design loads in accordance with AWWA D110-04, Section 3.3 and ASCE 7-02. The minimum roof live load for the structure shall be 12 psf.

E. Seismic conditions and design loads as specified in AWWA D110-04, Section 4.1

F. The thickness of the core wall shall be calculated so as to accept the initial compressive forces applied by prestressing, hydrostatic stresses induced by contents, and other applicable loads such as soil backfill and wind.

G. Backfill loads shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall.

2.03 CONCRETE FOUNDATION

A. CONTRACTOR shall design and construct a reinforced concrete foundation for the tank. All concrete shall be in accordance with Division 3–Concrete.

B. CONTRACTOR shall construct a concrete floor on grade inside the tank base.
   1. Slope floor 1/8-inch per foot toward the sump.
   2. All floors shall be designed for piping loads imposed which may require additional thickness or footing.

C. CONTRACTOR shall provide two copies of the foundation design calculations to ENGINEER along with the shop drawings. These shall not be shop drawings. They will be

retained for the project files. Calculations shall be signed and sealed by a Professional Engineer experienced in the work and licensed in the State of Kentucky.

D. CONTRACTOR shall incorporate all penetrations as specified.

E. Concrete membrane floors shall be a minimum of 12 inch thick and have a minimum thickness of 8 inches of concrete over all pipe encasements and around sumps.

F. A minimum percentage of 0.60% reinforcing steel shall be used in the membrane floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of 2 feet into the adjacent membrane floor.

2.04 CORE WALL

A. The core wall shall be constructed of shotcrete, encasing a steel diaphragm continuous the full wall height without horizontal splices.

B. The thickness of the core wall shall be calculated so as to accept the initial compressive forces applied by prestressing, backfill, and other applicable loads, but in no case be less than 3 1/2 inches thick.

C. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.

D. Interior and exterior surfaces of the core wall shall be water cured for a minimum of 7 days or until prestressing begins.

E. Core wall design shall take into account loading due to bending moments, shrinkage, differential drying, and temperature stresses.

2.05 STEEL SHELL DIAPHRAGM

A. A steel tank shell complying with ASTM A-1008 for Commercial Quality Cold Rolled Steel shall be used throughout the core wall, providing a waterstop. The steel shell diaphragm shall be encased and protected with shotcrete no less than 1 inch thick at all places.

B. The steel shell is to be formed and erected so that a mechanical key is created between the shotcrete and diaphragm.

C. The sheets of steel diaphragm shall be continuous from top to bottom of wall; horizontal joints or splices will not be permitted.

D. All vertical joints in the diaphragm shall be sealed watertight by epoxy injection in accordance with U.S. Patent No. 5,150,551.

E. Epoxy injection shall be carried out from bottom to top of wall using a pressure pumping procedure, after the steel shall has been fully encased, inside and outside, with shotcrete.

F. The sealant shall conform to the requirements of ASTM C881, Type III, Grade 1, and shall be 100% solids, moisture insensitive, low modulus epoxy system. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.

G. The epoxy sealant shall be suitable for bonding to concrete, shotcrete, and steel.

H. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to this waterstop.

2.06 SHOTCRETE

A. All shotcrete shall be applied by or under direct supervision of experienced nozzlement certified by the American Concrete Institute (ACI) as outlined in ACI certification publication CP-60.

B. Shotcrete mixes shall have a minimum of 1 part cementitious material to 3 parts of sand.

C. Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding of the following layer.

D. No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.

E. No less than 1/4 inch thick shotcrete shall separate reinforcing steel and prestressing wire, and in no case less than the diameter of the wire or strand. A minimum of one inch cover shall be provided over the final layer of wire or strand.

2.07 DOME ROOF

A. The clear span dome roof shall be constructed of reinforced concrete and circumferentially prestressed.

B. Dome shell reinforcement shall consist of reinforcing bars or welded wire fabric meeting ASTM A185, not galvanized. Bolsters for wire fabric and reinforcing bars shall be plastic tipped. Wire ties shall be galvanized.

C. The dome ring girder shall be prestressed with sufficient wire to withstand the dome dead load and design live loads. The ring girder shall have cross section suitable to accept the applied prestressing forces.

D. The high water level in the tank shall be permitted to encroach on the dome shell no higher than the upper horizontal plane of the dome ring girder.

E. Overflow outlets or the overflow pipe shall be capable of providing an overflow open area three times the area of the largest tank pipe.

F. The dome roof shall be cured for a minimum of 7 days or until prestressing begins.

G. The dome shall be designed as a free-span, spherical thin shell with one-tenth rise in accordance with the following:
   1. Typical Dome Design: The typical dome thickness and steel reinforcement shall meet the requirements of AWWA D110-04, Section 3.6.3 "Thickness and reinforcement". In all cases, the thickness of the dome shall be no less than 3 inches.
   2. Dome Edge Design: The dome edge and upper wall shall be designed to resist the movements, thrusts, and shears that occur in this region due to dome and wall prestressing and loading conditions.

2.08 HORIZONTAL PRESTRESSING

A. Circumferential prestressing of the tank shall be achieved by the application of cold-drawn, high-carbon steel wire complying with ASTM 821 Type B, placed under high tension. A substantial allowance shall be made for prestressing losses due to shrinkage and plastic flow in the shotcrete and due to relaxation in the prestressing steel.

B. Placement of the prestressing steel wire shall be in a continuous and uniform helix of such pitch as to provide in each linear foot of core wall height an initial force and unit compressive stress equal to that shown on the design drawings. Splicing of the wire shall be permitted only when completing the application of a full coil of wire or when removing a defective section of wire.

C. Areas to be prestressed will contain not less than 10 wires per foot of wall for 8 gauge and 8 wires per foot of wall for 6 gauge. A maximum of 24 wires per layer per foot for 8 gauge and 20 wires per layer per foot for 6 gauge will be allowed. Shotcrete shall be used to completely encase each individual wire and to protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires is to be no less than one wire diameter.

D. Prestressing shall be accomplished by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the manufacturer's design.

E. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. The stress measuring equipment shall include:
   1. Electronic direct reading stressometer accurate to within 2%.
   2. Calibrated dynamometer.
   3. Test stand to verify the accuracy of the equipment.

F. After circumferential prestressing wires have been placed, they shall be protected by encasement in shotcrete. This encasement shall completely encapsulate each wire and permanently bond the wire to the tank wall.

G. When multiple layers of wire are required, shotcrete cover between layers shall be no less than AWWA D110-04 requirements.

H. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1 inch shall be placed over the prestressing wires.

2.09 WALL OPENINGS

A. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe or sleeve shall be no less than 18 inches above the floor slab, and the prestressing wires required at the pipe elevation shall be distributed above and below the opening leaving an unbanded strip around the entire tank.

B. Unbanded strips shall have a vertical dimension of no more than 36 inches unless an axi-symmetric shell analysis is performed to account for shear and moments caused by displacement of the prestressing wires into adjacent bands.

C. All wall pipes and sleeves passing through the wall shall be sealed to the steel shell diaphragm by epoxy injection.

2.10 TANK ACCESSORIES

A. The tank manufacturer shall furnish and install tank accessories as required in this section and as sized and detailed in the Drawings.

B. The tank shall have two rectangular Type 316 stainless steel wall manholes for access to the interior of the tank. The cover and the bolts shall be of Type 316 stainless steel.

C. Provide one interior fiberglass ladder with Type 316 stainless steel fasteners and climbing device conforming to applicable OSHA standards.

D. Provide one fiberglass roof hatch cover and one fiberglass roof ventilator with Type 316 stainless steel fasteners. Ventilator openings shall be screened.

E. Provide four precast concrete overflow openings. Openings shall be screened.

PART 3–EXECUTION

3.01 CONSTRUCTION

A. CONTRACTOR is responsible for all clearing and grubbing within the "area of site" as shown on the Drawings. All construction activities with respect to the tank shall be contained within the area of site.

B. Excavation for the foundation shall continue through the weathered portion of the bedrock until sound bedrock is reached.

C. After the bedrock surface is reached, the excavation shall be cleaned of loose soils and be tested for soundness with a 1-inch-diameter pneumatic drill-hammer for a minimum vertical distance of 5 feet below the bedrock surface. Tests shall be uniformly placed in staggered rows around the foundation footing.

D. Elevated tank foundations shall be founded directly on sound bedrock, or lean mix concrete (2,500 psi) shall be placed on the sound bedrock to an approved elevation of bottom of tank foundations.

E. CONTRACTOR shall topsoil, final grade, and seed the entire "area of the site" and all other areas disturbed by CONTRACTOR.

3.02 SAFETY CLIMB EQUIPMENT

A. Install equipment on all ladders as specified and in accordance with manufacturer's instructions.

B. Install all identifications and labels provided with the equipment.

3.03 REPAIR/RESTORATION

A. All surface improvements and underground utilities to remain in place that are disturbed by this Contractor shall be restored to their original condition under this Contract. Replacement methods shall be approved by OWNER of such improvements and underground utilities.

3.04 CLEANING AND DISINFECTION

A. CONTRACTOR shall sterilize tank to provide tank surface which is free from bacteria. The sterilization procedure shall conform to spray sterilization procedure as described in AWWA C652.

B. All interior surfaces of the tank which are in the water containment area shall be thoroughly sprayed to run off with water containing 200 parts per million of chlorine. This solution can be obtained by adding one ounce of calcium hypochlorite (HTH) powder to each 26 gallons of water (HTH powder containing 70% available chlorine).

C. After one hour, the structure may be filled with potable water. OWNER will take water samples for bacterial analysis. Two safe samples will be required to be obtained for conformance with sterilization procedure.

D. Personnel working inside the tank during sterilization shall be equipped with suitable air masks and safety lines leading through a manhole to personnel outside the tank. All safety precautions shall be observed.

E. The interior of the riser pipe shall also be sterilized. CONTRACTOR shall select the method and submit it to ENGINEER for review.

3.07 EXAMINATION

A. Verify elevations, placement, and grading for tank prior to starting tank construction.

3.08 INSTALLATION

A. Tank Floor:
   1. The floor shall be vibratory screeded to effect consolidation of concrete and proper encasement of floor reinforcing steel.
   2. The floor shall be continuously water cured until tank construction is completed.
   3. Floor shall receive a bull float finish.

B. Tank Wall:
   1. The wall shall be constructed in a predesigned manner utilizing steel shell diaphragm, layers of shotcrete, and prestressing wire.
   2. The diaphragm shall be protected against damage before, during, and after erection. Nail or other holes shall not be permitted in the steel shell for erection or other purposes except for inserting wall pipes or sleeves, reinforcing steel, bolts, or other special appurtenances. Such penetrations shall be sealed with an approved epoxy sealant.

3. Interior and exterior portions of the shotcrete wall shall be water cured for a minimum of 7 days or until prestressing is started.
4. Exterior face of shotcrete walls shall receive a natural gun finish. Interior face of shotcrete walls shall receive a finish as specified in AWWA D110-04 Section 5.3.2.2.4

C. Roof:
1. All concrete shall be consolidated by means of a vibrator for proper encasement of reinforcing steel and welded wire fabric.
2. All surfaces at the joint between the wall and the dome shall be coated with an approved bonding epoxy.
3. Dome shall be water cured for 7 days after casting or until prestressing is started.
4. Exterior surface of the cast-in-place dome shall receive a light broom finish.

D. Prestressing: The initial tension in each wire shall be read and recorded to verify that the total aggregate force is no less than that required by the design. Averaging or estimating the force of the wire on the wall shall not be considered satisfactory evidence of correct placement of prestressing wires.

3.09 FIELD QUALITY CONTROL

A. Inspection and Testing:
1. Hydrostatic Testing: Test completed tank for liquid tightness by filling tank to its overflow elevation with water provided by OWNER prior to backfill placement. Test for water tightness shall be according to AWWA D110-04 Section 5.13.
2. Concrete and Shotcrete Testing: Test all concrete and shotcrete used in the tank structure in accordance with Section 03300.

3.10 CLEANING AND DISINFECTION

A. Clean interior and exterior of tank to remove debris, construction items, and equipment.

B. Disinfection Procedure: Use AWWA C652 Method 2 or 3.

END OF SECTION

SECTION 14600

HOISTS AND CRANES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hoists.
   2. Trolleys.
   3. Bridge cranes (top running).
   4. Flat cable festoon systems.
   5. Electrical system controls.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. CMAA–Crane Manufacturers Association of America.

B. MHI–Material Handling Institute, Inc.

C. ANSI–American National Standard Institute.

D. HMI–Hoist Manufacturers Institute.

E. MMA–Monorail Manufacturers Association.

1.03 SYSTEM DESCRIPTION

A. Crane System: Top running crane systems shall include items specified in this section as appropriate and all other specified accessories necessary to provide a complete functioning system.

1.04 DESIGN REQUIREMENTS

A. Crane systems shall be designed and manufactured in accordance with CMAA specification No. 74, "Specifications for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist."

B. Underhung crane and monorail systems shall be designed and manufactured in accordance with ANSI MH 27.1–1981, "Monorail Manufacturers Association Specifications for Underhung Cranes and Monorail Systems." Where design standards of the CMAA and MMA conflict, the CMAA standards shall govern.

C. Hoists shall be designed and manufactured in accordance with the standards of the Hoist Manufacturers Institute.

1.05 PERFORMANCE REQUIREMENTS

A. Crane System: CONTRACTOR shall conduct start-up and testing of crane system to demonstrate that load capacity and total system operation meet the requirements and intent of the Contract documents.

1.06 SUBMITTALS

A. Submittals shall be in accordance with provisions of Section 01300–Submittals.

B. Submit type, brand, and thickness of primer paint to be furnished on bridge cranes, runway beams, and monorails.

PART 2–PRODUCTS

2.01 BRIDGE CRANE

A. Bridge crane shall consist of a top running single girder bridge supported on four-wheel end trucks at each end. End trucks shall run on two runway beams located where shown on the Drawings. End trucks shall be dual motor driven with 460 volt, 3 phase motors.

B. Acceptable manufacturers include the following, or equal:
1. UESCO Cranes, Inc.–Worth, Illinois.
2. ACCO Chain and Lifting Products–York, Pennsylvania.
3. Lift Crane and Conveyor.

C. Crane schedule is as follows:

Building	Load Capacity	End Truck Motor Size	Motor Speeds
Pump Station	7.5 ton	1.5 hp	50 fpm

D. Crane service classification shall be Class A–Standby Service, or better.

2.02 HOISTS

A. Hoists shall be Robbins & Myer (R & M), or equal, electric chain hoists. Motors shall be 460 volt, 3 phase, 60 Hz. Provide chain container with hoists.

B. Hoist schedule is as follows:

Building	Model	Load Capacity	Motor Size	Speeds	Lift Height
Pump Station	SX4-061	7.5 ton	1.9 hp	12.5 fpm	32' 9"

2.03 TROLLEYS

A. Trolleys shall be Robbins and Myer (R & M), or equal. Trolley motors, where required, shall be 460 volt, 3 phase, 60 Hz.

B. Trolley schedule is as follows:

Building	Model	Load Capacity	Motor Size	Speeds
Pump Station	SX4-061	7.5 ton	1.9 hp	12.5 fpm

2.04 FLAT CABLE FESTOON SYSTEM

A. Heavy-duty C-track flat cable festoon system shall be provided at the following locations:

Building	System	Mounting Location	Function
Pump Station	Bridge Crane	Running Beam	Bridge girder end trucks
		Bridge Girder	Power to hoist and trolley

B. Tracks, support brackets, and accessories shall be galvanized steel.

2.05 ELECTRICAL SYSTEM CONTROLS

A. Controls for bridge crane shall be pendant mounted and provided by the crane manufacturer. The system shall operate utilizing a 480 volt, three phase power source.

2.06 FINISHES

A. Bridge crane runway beam and monorail beams shall be painted in accordance with Section 09900–Painting requirements for steel, machinery, and equipment not submerged. Primer shall consist of one shop coat of Tnemec 69-1255 Hi-Build Epoxoline primer, 5.0 mils DFT. Load capacity shall be stenciled on the bridge and monorail beam after finish painting.

B. Hoists and trolleys shall be factory-finished painted with the manufacturer's epoxy paint finish system.

PART 3–EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Install equipment as indicated and according to supplier's and manufacturer's instructions.

B. CONTRACTOR shall inspect the units after delivery to the site for any damage to the units during shipping.

3.02 FIELD QUALITY CONTROL AND DEMONSTRATION

A. Provide manufacturer's services for the following:
   1. Start-up.
   2. Field Testing. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted.

Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report.

3. Operator training and final adjustment.

B. Supervision and Start Up: Installation of all equipment furnished under this Contract shall be supervised as required by a qualified representative of equipment manufacturer. All equipment shall be placed in operation, and the plant operator shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentation given by manufacturer's representatives.

3.03 FINISHING

A. CONTRACTOR shall provide finish paint as required by Section 09900–Painting.

3.04 ADJUSTING, CLEANING, AND PROTECTION

A. CONTRACTOR shall provide final adjusting, cleaning, and protection in accordance with Division 1. CONTRACTOR shall make all final adjusting on equipment as required by manufacturer. CONTRACTOR shall leave equipment in a clean condition.

3.05 LUBRICATION

A. CONTRACTOR shall furnish a one-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

END OF SECTION

SECTION 15000

GENERAL REQUIREMENTS FOR MECHANICAL WORK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All material, piping and installation for piping and appurtenances, mechanical insulation, plumbing, heating, ventilating, and air conditioning.
   2. Concrete foundations and anchor bolts for all equipment furnished under this division.
   3. Connections to all equipment whether furnished under this division or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

C. Work of Other Divisions: CONTRACTOR for this work shall coordinate its work with that of any other contractors working in the same construction area. The contractors shall make a mutual agreement as to when piping and appurtenances shall be installed so as to minimize interference with each other's work.

D. Finishes: Unless otherwise specified, valves, piping, and mechanical equipment items shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC, and underground piping) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Piping and fittings in wet well areas need not be painted.

E. Electrical Controls: All electrical controls shall be furnished and installed under Division 16, except for those items specified to be furnished with the equipment. Where electrical controls are specified to be furnished with the equipment, electrical controls shall be in accordance with Division 16 unless otherwise specified.

F. Equipment Foundations: CONTRACTOR shall construct concrete foundations for all equipment and control panels under this Contract unless noted otherwise. Foundations shall generally be at least 4 inches high, shall consist of six-bag mix concrete, anchor bolts, reinforcing rod dowels into building concrete, and grouting with nonshrink element (containing no iron filings) where required. More specifically, concrete and grout shall meet the requirements found in Division 3.

G. Concrete: All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 3.

1.02 SUBMITTALS

A. See Section 01300–Submittals for shop drawing submittal procedures.

B. Applicable provisions of Section 01300–Submittals cover requirements for Operation and Maintenance Manuals.

C. Applicable provisions of Section 01700–Contract Closeout govern requirements for record drawings, operation and maintenance data, and warranty information.

1.03 DELIVERY STORAGE AND HANDLING

A. Applicable provisions of Section 01600–Materials and Equipment govern the handling, storage, and protection of materials and equipment.

1.04 SEQUENCING

A. Applicable provisions of Section 01010–Summary of Work govern construction sequencing.

1.05 WARRANTY

A. Applicable provisions of Section 01700–Contract Closeout govern product warranties.

1.06 SYSTEM START-UP

A. Applicable provisions of Section 01650–Starting of Systems govern start-up and testing.

B. Installation of all equipment furnished under this contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to his satisfaction.

C. All costs of supervision, operator training, and start-up shall be included in the contract price.

1.07 MAINTENANCE

A. CONTRACTOR shall furnish a one-year supply of grease and oils for all items of equipment requiring lubrication. Lubricants for all items of equipment shall be the same brand, when available, as recommended by the manufacturer to meet both warm and cold weather requirements.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3--EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 15040

PIPING AND ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Aboveground and exposed piping and valves of every description.
   2. Wall pipes and fittings.
   3. Concrete foundations and anchor bolts for all equipment furnished under this section.
   4. Piping connections to all aboveground or exposed equipment whether furnished under this section or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Shop Drawings: General arrangement drawings of all interior cast or ductile iron or steel piping with all equipment attached shall be submitted to ENGINEER for approval prior to installation. Additional shop drawing requirements are found in the General Conditions and Division 1. Drawings shall include proposed length, location and elevation of pipe, fittings, valves, and other appurtenances.

PART 2–PRODUCTS

2.01 MATERIALS–GENERAL

A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF)-approved.

2.02 PIPE MATERIALS

A. Ductile Iron Piping and Fittings:
   1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C151.
   2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 350 psi.
   3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to AWWA C110 and C115 and shall be compatible with ANSI B16.1 Class 250. Flanges shall be cast or ductile iron.
   4. Flanged gaskets shall be minimum 1/8-inch-thick rubber "ring" gaskets, not full faced gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerances.

5. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc., Sika FLEX 1-A, or equal.
6. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressures and installation conditions specified or shown.
7. Interior fittings shall be flanged and of ductile or cast iron. Flange fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 250 psi.
8. All flanged sections of pipe shall be made up in accordance with AWWA C115 specifications. No field make-up flanges will be allowed unless strictly conforming to AWWA C115 with facing done after turning pipe through flange.
9. Interior pipe and fittings shall be cement-mortar lined and asphaltic coated inside and shall be shop primed outside. Submerged pipe and fittings shall be cement mortar lined and asphaltic coated inside and asphaltic coated outside. Cement-mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Shop priming with products equal to and compatible with those listed under painting in Division 9 of these specifications shall be provided.

B. Copper Piping:
1. Copper piping shall conform to the requirements of the "Specifications for Seamless Copper Water Tube," ASTM B88.
2. Unless otherwise shown or specified, all interior or aboveground potable and nonpotable water supply piping 3 inches in diameter or smaller shall be Type K hard copper.
3. Fittings shall be soldered or sweated on and shall be of cast bronze or forged brass containing 85% copper.
4. All underground water supply piping 3 inches or smaller shall be Type K soft copper with compression fittings. Joints shall not be used under floor slabs.
5. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
6. Pump vent and drain lines, manometer lines and lines to pressure gauges above the floor shall be rigid, Type K, hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.

C. Galvanized Iron Piping:
1. Where shown or specified, all galvanized piping shall be Schedule 40 galvanized iron pipe with galvanized malleable iron fittings.
2. An ample number of unions shall be provided for disassembling pipe.
3. Pipe shall conform to the "Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses," ASTM A53.

D. PVC Piping:
1. PVC shall conform to ASTM D1784, Class 12454-B.
2. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467 and for threaded ASTM D2464.
3. All piping shall be approved for use by the National Sanitation Foundation.
4. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are shown on the Drawings or where

transition to another pipe material is required. Pipe shall be installed in compliance with ASTM D2321 except as otherwise specified herein.

5. Schedule 40 PVC pipe may be used for plumbing vents where allowed by code.

E. Drainage Piping:

1. Except as shown, all drainage, waste, soil, and vent piping shall be first quality, service grade cast iron hub and spigot pipe, tarred inside and outside, free of flaws and defects, and conforming to ASTM A74.
2. Rubber gasket joints conforming to ASTM C564 may be used below ground. No hub joints may be used aboveground provided that they conform to the Plumbing Code.
3. No bends shall be sharper than 1/8 or long sweep 1/4.
4. Ends of all runs and stacks shall have cleanouts and screwed plugs. PVC pipe may be used for roof drain leaders, downspouts, and vent piping in buildings where allowed by Code.

F. Drain, Waste, and Vent (DWV) Piping:

1. Drain, Waste, and Vent (DWV) Piping:
   a. All building drain, waste, clear water and vent piping (DWV) and piping in or within 2 feet of buildings or buried under slabs may be PVC pipe as specified herein or cast iron soil pipe as specified above.
   b. Aboveground waste, conductor, clear water, and vent piping and fittings within the building shall be Schedule 40 or Schedule 80 PVC conforming to ASTM 1785, D3311, and ASTM D2665 standards.
   c. Sanitary, clear water and storm building sewers that penetrate exterior foundation walls shall be ductile iron from 2 feet beyond the wall.

2.03 VALVE MATERIALS

A. Gate Valves:

1. Where shown or specified, gate valves in lines 4 inches in diameter or larger, shall be AWWA C500 iron body, bronze mounted, nonrising stem, double disk, parallel seat, Class 250, O-ring stem seals.
2. All interior valves shall be flanged and have handwheels. Right angle operators shall be provided if required because of valve position.
3. Underground valves shall have either mechanical joints or push-on joints, extended stem for maximum depth of 5 feet from operating nut to surface, valve box, and key. Valve boxes shall be cast iron telescopic adjustable.
4. Shutoff valves in water lines 3 inches to 1 inch in diameter shall be gate valves, Class 150 bronze or iron body bronze mounted, solid wedge disk, threaded, rising stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.

B. Tilted Disk Check Valves:

1. The check valves in each of the 20-inch pump discharge lines shall be of the tilted disk, full-body flanged-type.
2. Each valve housing shall consist of two body sections bolted together at a central diagonal flange which shall be inclined at an angle of 55°. The inlet body section shall contain a seat ring positioned and captured by the diagonal flange. The outlet body section shall accept two eccentrically located in-line pivot trunnions about which a disk shall rotate.

3. Each disk shall travel no more than 40° from the closed to the fully open position. The design contours of the disk and its position during flow must prevent disk flutter at a minimum flow velocity of four (4) fps.
4. The flow area through each valve body inlet and outlet shall be equal to pipe size and gradually increased to an area 40% greater than pipe size through the valve seat.
5. Inspection ports shall be provided upstream of each valve disk. An indicator must be supplied and visually show the disk position at all times. Signal switches shall be included with the indicators.
6. Materials of Construction: Body sections to be cast iron ASTM A48, Class 30, disk to be cast iron ASTM A48, Class 30, seat ring to be centrifugally cast aluminum bronze ASTM B271, copper alloy #954. Disk ring to be centrifugally cast aluminum bronze ASTM B271, copper alloy #955. Pivot pins to be aluminum bronze ASTM B505, copper alloy #955. Pivot pin bushings to be aluminum bronze ASTM B505, copper alloy #954. Provide with ANSI B16.1 Class 285 flanges. Material package shall be 9620.B. Bottom mounted oil dashpot to be included, installed in the bottom/upstream inspection part.
7. Each tilted disk check valve shall be equal to series 9000 Val-Matic.

C. Small Check Valves: Check valves in other than cast iron lines shall be Milwaukee Valve 510, Nibco T-433, screwed end bronze swing check for water, air, and gas. Provide unions to allow for ease of removal.

D. Butterfly Valves:
1. General:
   a. Except as otherwise specified or shown on the Drawings, shut-off valves in lines 4 inches in diameter or larger shall be butterfly valves.
   b. Butterfly valves shall be AWWA C504, short body, Class 150B. Provide certified drawings by manufacturer and affidavit of compliance.
   c. Valve bodies shall be cast iron (ASTM A126, Class B) or ductile iron ASTM A536. Valves shall be flanged interior exposed and mechanical joint underground and conform to ANSI B16.1 Class 125.
   d. Valve shaft shall be stainless steel.
   e. Valve disk shall be cast iron.
   f. Valve seat shall be constructed of synthetic rubber compound and shall be recess mounted and bonded in the valve body or attached to the disk. Seat shall be mechanically attached to the valve body or seat with screws, bolts, clamping rings, or similar devices.
   g. Valve shaft bearing shall be self-lubricating Teflon, nylon, or bronze.
   h. Shaft seals shall have split V-type packings that are replaceable without removing the valve from the line.
2. Standard Operators:
   a. Except as noted below, butterfly valves shall be equipped with top-mounted handwheel operators with totally enclosed, sealed, and lubricated gear boxes.
   b. The rated torque capability of each operator shall be sufficient to seat, unseat, and hold any valve disk position with the maximum pressure differential across the valve without creep or fluttering.
   c. Exposed valves shall be equipped with handwheels and valve disk position indicators and shall be equipped with field adjustable mechanical stop-limiting devices.
   d. Valves for buried service shall be furnished with 2-inch square wrench nuts, extended stem, valve box, and key. Valve boxes shall be cast iron telescopic adjustable.

E. Pump Control Ball Valves:
   1. Pump control ball valves in the three water discharge lines shall be electric operated 20-inch Henry Pratt ball valves, or equal, suitable for water application.
   2. The valves shall comply with AWWA C507.
   3. Valve shall be designed to operate under a working pressure of 350 psi.
   4. Valve flanges shall conform to ANSI B16.5 Class 300. Downstream flange of both ball valves shall be drilled and tapped to mate with Class 250 flanges.
   5. Valve design shall eliminate metal-to-metal contact or wedging in sealing action and shall effect tight shut-off against flow back into the well.
   6. Valve sealing shall be accomplished by use of a heavy rubber seat mating against a stainless steel body seat. The rubber seat shall be replaceable without disassembly of valve or operator. Electrical operator shall conform to specifications herein.

F. Electric Valve Operators:
   1. Provide electrical valve operators Limitorque, Auma, or equal.
   2. Provide space heating element in housing.
   3. Operator shall be capable of holding valve in an intermediate position between fully open and fully closed without creeping or fluttering.
   4. Gearing on electrical operators shall be totally enclosed and shall operate in lubricant.
   5. The operator shall have torque capabilities at least 1 1/2 times the required torque. Torque switches shall be provided to stop motor operation in the event of a mechanical overload.
   6. Handwheel shall be provided for manual opening and closing of valve without electric power.
   7. Provide declutch lever to prevent accidental opening or closing of valve with handwheel.
   8. Provide valve position indicating dial. Operator shall be positioned to accommodate installation conditions.
   9. Provide an integral valve operator motor starter and pushbutton station for local control of each valve. Pushbutton station shall consist of three pushbuttons for open, close, and stop control and two lights to indicate valve position. Green shall indicate fully open and red shall indicate fully closed. Both lights shall be on when valve is in intermediate position. Provide local/remote switch.
   10. Operation of valve shall be interlocked with the control of the corresponding pump motor. See Division 16 for interlock requirements.
   11. Valve shall act to limit surge pressures which might occur upon starting and stopping the pump. The valve shall open and close slowly under operation; all necessary accessories, pressure and limit switches, contacts, and controls shall be provided to accomplish these functions even though not specifically enumerated herein.
   12. The valve shall open to 90° in no less than 60 seconds after the pump motor starts. Valve position sensing shall be by the pump discharge check valve sensed by a mercury switch on the lever arm of the valve.
   13. On the booster pumps, if the valve does not open after 120 seconds, the pump motor shall stop.
   14. On normal shutdown, the valve shall close in 60 seconds and the pump motor shall be stopped when the valve is nearly closed.
   15. Normal pressure at the discharge valve is 200 psi while open. Pressure while closed will be 25 psi on upstream side when pump is not operating and 85 psi on downstream side. Upstream pressure when pump is running and valve is closed may be 350 psi.

G. Air Release Valve:
   1. The air release valve shall be 1-inch APCO Model #50 Val-Matic No. 15A, or equal.
   2. The valve assembly shall be installed as shown on Drawings.
   3. CONTRACTOR shall run 1/2-inch pipe from the top of the valve as shown. Screen end of pipe.

H. Miscellaneous Valves:
   1. Shut-off valves in PVC piping shall be 150 psi PVC ball valves, Chemtrol TU Series Tru-bloc, Walworth Series 8927, Wallace & Tiernan, or equal.
   2. Solenoid valves shall be 300 psi ASCO Red Hat, or equal. Coordinate voltage with Division 16 Electrical Contractor.
   3. Provide unions for ease of valve removal. For transition from PVC to metal, use Chemtrol transition unions.
   4. For pressures <80 psi, provide 1/2-inch chrome-plated smooth end sampling cock, Zurn Z-80401, or equal. For pressures >80 psi, provide 1/2-inch satin brass smooth end sample cock, Conbraco 26-314, or equal.
   5. Shut-off valves in potable water lines smaller than 1 inch shall be Milwaukee 1131 (threaded) or Milwaukee 1169 (solder joint) Nibco T-134 (threaded) or Nibco S-134 (solder joint) or equal, bronze 300 psi gate valves.
   6. Corporations in potable water lines (3/4-inch or 1-inch) shall be Mueller H 15008 compression-type fittings, or equal.
   7. Exterior hose valves shall be Woodford Model 65, Ken-Ray Model 120, or equal freezeless wall hydrants with integral Nidel 34HA vacuum breaker, permanent valve seat, and brushed chrome exterior face with 3/4-inch garden hose threads. Provide separate interior shut-off valves as specified herein.
   8. Interior hose valves shall be Woodford Model 24, Jenkins 112, or equal, 3/4-inch garden hose thread. Interior hose valves on the potable water system shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal.

I. Surge Relief Valve:
   1. Two surge relief and refill valves shall be installed as shown on the Drawings. The valve shall be designed for the following functions.
   2. Open at preset high pressure to release surges into the reservoir. Normal pressure in the pump discharge header will vary from {_____} to {_____} psi. Head downstream of the valve may vary from {_____} feet to {_____} feet of positive head. Valve shall be designed to release all surges above {_____} psi.
   3. The surge relief valve shall be equal to a GA Industries 16-inch globe style relief valve with three pilot controls.
   4. The valve shall be designed to withstand cavitation. Provide cast iron valve with chrome-plated piston and seat crown. Provide stainless steel skirt on piston and stainless steel tube downstream of piston to protect valve body. The skirt shall be specially fabricated with holes designed and drilled to dissipate the pressure from the distribution system.
   5. The surge relief valve shall consist of a diaphragm-activated "main" control valve and shall consist of all necessary mechanical and electrical accessories to adjust the "main" valve to achieve the previously described functions. The main valve shall be a hydraulically-operated, diaphragm-actuated, angle globe pattern valve manufactured in ductile iron per ASTM A536.
   6. The main valve shall contain a resilient, synthetic rubber disk forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and

shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. All necessary repairs shall be possible without removing valve from the line. Valve shall have 250 psi flanges.

7. Manufacturer of surge relief valve shall confirm model number to written description above and shall submit letter with shop drawings stating the valve will function as intended under the conditions shown on the Drawings specified herein.
8. Pilot controls shall be panel wall mounted. Unions shall be provided in the control lines at the valve and also at the control panel.

2.04 COUPLINGS AND RESTRAINT MATERIALS

A. Pipe Coupling: Pipe couplings identified on the Drawings shall be equal to Dresser Type 38, Rockwell 411, or equal coupling. CONTRACTOR shall provide tension ties and tie ears as shown on the Drawings and specified herein.

B. Rubber Expansion Joints:
1. Rubber expansion joints shall be furnished and installed as shown.
2. Expansion joints shall be the single, nonfilled arch-type as manufactured by Mercer Rubber Company, General Rubber Co., or equal.
3. Each expansion joint shall be furnished complete with control rods and rubber washers to resist excessive deflection at rated working pressures.
4. Expansion joints shall have integral duct and rubber flanges with split backup rings and have a rated working pressure of 150 psi and 15 psi vacuum.
5. Expansion joints shall meet or exceed the chemical resistance characteristics of chlorobutyl elastomers suitable for potable water usage.

C. Tension Ties:
1. All tension ties, rod ties, and control rods shall be provided to resist a minimum 150 psi (250 psi surge allowance) pressure in the pipe line.
2. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary with dimensions as shown on the Drawings.
3. Rods shall be provided with nuts and washers on both sides of tie ears.
4. All nuts shall be carbon alloy steel conforming to A563, and washers shall be hardened steel conforming to ASTM F436.
5. Rods shall be ASTM A36 steel at a minimum.
6. Tie rods shall be equally spaced around pipe.
7. The following tables lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

	150 psi Pressure		250 psi Pressure	
Pipe Size (Inches)	Minimum Number	Minimum Size (Inches)	Minimum Number	Minimum Size (Inches)
4-10	4	5/8	4	5/8
12	4	5/8	4	3/4
14	4	3/4	4	7/8
16	4	3/4	4	1
18	4	7/8	4	1 1/8
20	4	1	4	1 1/4
24	4	1 1/8	4	1 1/2
30	4	1 3/8	7	1 3/8

	150 psi Pressure		250 psi Pressure	
Pipe Size (Inches)	Minimum Number	Minimum Size (Inches)	Minimum Number	Minimum Size (Inches)
36	8	1 1/4	8	1 1/2
42	12	1 1/8	12	1 1/2
48	11	1 3/8	22	1 1/4
54	11	1 1/2	22	1 3/8

D. Quick Hose Disconnect: Quick hose disconnects shall be 2-inch polypropylene, Ever-tite F-adapter type, as manufactured by American Packing and Gasket Company. Lockable dust cap and padlocks shall be provided for each disconnect. All padlocks shall be keyed identically.

E. Mechanical Seals: Mechanical seals shall be 316 stainless steel link seal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners. Sleeve diameter shall be provided and mechanical seals installed as recommended by the manufacturer.

F. Pulsation Dampener: Pulsation dampeners shall have PVC housing with Hypalon seals. Pulsation dampeners shall be Model PDS-80, as manufactured by Lutz-JESCO.

2.05 MATERIALS–NONSHRINK MORTAR

A. Nonshrink mortar shall be All-Crete as manufactured by Concrete Products, Inc., Woodland, California; Speed Crete as manufactured by Tamms Industries Co., Itasco, Illinois; or equal. Nonshrink mortar shall be placed in accordance with manufacturer's recommendations.

2.06 EQUIPMENT–PRESSURE GAUGES

A. Gauges are to be aluminum 6-inch ANSI B40.1, Grade 2A bourdon gauges and be equipped with properly sized Ray pressure snubbers and brass shutoff valves.

B. Gauges shall be accurate to ±1/2% of scale range.

C. Gauges shall be Trerice No. 500-X Series, Ashcroft Duragauge, or equal.

D. Gauges shall be as follows:
1. Three discharge gauges graduated in psi, range 0 to 350 psi.
2. Located in taped bosses of each of the four tilted disc check valves.

E. Venturi Meter:
1. Metering equipment shall consist of a primary element in the 42-inch discharge line and a wall-mounted instrument.
2. The primary element shall be a primary flow signal, HVT-CI. Venturi shall be cast iron body with stainless steel throat and ANSI pound-rated flanges.
3. Range shall be 4,000 to 21,000 gpm with normal operation at 4,200 gpm, 1% overall accuracy.
4. Transmission between the primary element and instrument shall be hydraulic through two lines of 1 1/4-inch copper tubing, sloped to instrument at minimum 1/2-inch per foot. Verify sensing line sizes and slope with manufacturer. Provide isolation valves at Venturi on connecting lines.

5. See Division 16 for secondary differential pressure device.

2.07 EQUIPMENT–SUMP PUMP

A. Furnish and install three sump pumps located where shown on the Drawings.

B. The sump pump shall have a capacity of about 30 gpm at 25 feet total dynamic head.

C. Pump shall be Hydromatic, or equal, minimum 1/3 hp, 115 volt, single phase, 60 cycle, oil filled.

D. Pump shall be heavy-duty with cast iron housing, bronze impeller, and stainless steel shaft.

E. Pump shall be provided complete with diaphragm pressure switch level control system to start and stop the pump, starters as required, and sealed power cables.

F. Pump shall have factory-applied paint. Discharge piping from each pump shall be 1 1/2-inch and shall include one flexible connector, check valve, and one gate valve for pump as shown on the Drawings.

G. Provide Enpo, Hydromatic, or equal fiberglass sump with cover complete with discharge pipe openings, 3-inch vent, and openings for level control, and power cables. Covers shall have a diameter as required to accommodate simplex or duplex pump arrangement as shown on the drawings, and a thickness of 1/2-inch. Sump depth shall be as required to receive drain lines, and pump and shall be as shown on the Drawings.

2.08 FINISHES

A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR, with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 9. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec 69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be 140-1255 Beige Pota-Pox Primer and shall be NSF-approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

B. Factory standard prime finish for valves and meters is acceptable if material is compatible with epoxy finish coat specified in Division 9. Primer used shall be compatible with proposed finish coats; CONTRACTOR to verify.

PART 3–EXECUTION

3.01 INSTALLATION

A. Size, Type, and Joining: All materials shall conform to the size and type shown on the Drawings or called for in the specifications. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted to ENGINEER for review.

B. Unless shown otherwise, underfloor piping shall clear floor slabs and footings by a minimum of 6 inches.

C. Support:
1. All interior or exposed pipelines, except in chemical feed rooms, shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
2. Exposed piping in chemical feed rooms shall be supported with a plastic support system, Aikinstrut Series K, or equal.
3. Strap hangers, tin clips, or U-hooks will not be acceptable.
4. Piping shall be supported, even though not shown on the Drawings, with base fittings and concrete pads when bottom of pipe is less than 6 inches above the floor, with Grinnell 264, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and with Grinnell or equal adjustable iron or heavy steel pipe hangers with supporting clamps or inserts more than 6 feet above the floor.
5. In general, the maximum spacing of supports shall not exceed 10 feet on centers unless approved by ENGINEER.
6. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code.
7. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
8. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties.
9. The weight of the piping shall be supported independently of connected equipment.

D. Penetrations:
1. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping.
2. The sleeve diameter shall not exceed the pipe O.D. (or flange O.D. where applicable) plus 2 inches, unless otherwise shown on Drawings.
3. If the concrete members are to be watertight, the annular space around the pipe shall be caulked with lead wool or sealed with an approved mechanical seal.
4. For copper pipe provide an elastomeric sleeve on pipe where it passes through walls or slabs.
5. Where pipes pass through nonwatertight walls, the annular space shall be grouted full.
6. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation, and the annular space shall remain open.
7. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the wall and provide a wall sleeve or wall pipe.
8. Space between wall sleeve or wall pipe and concrete shall be filled with nonshrinking mortar.

9. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.
10. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
11. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise approved to achieve a watertight seal.
12. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without prior consultation with ENGINEER.
13. All openings for pipe work shall be neatly patched in a workmanlike manner.

E. Layout:
1. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work.
2. Care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.
3. Piping shall not interfere with headroom or clear floor space.
4. Unless otherwise shown, small water piping shall be concealed in (except reinforced concrete walls) walls placed in piping pits, above suspended ceilings, or under floors where possible, or as shown on the Drawings.
5. Pipes under floors shall have a minimum of 6 inches of sand cover.
6. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring-, and snap-type.
7. An ample number of unions shall be provided in all threaded, soldered, and glued pipelines and at all equipment to facilitate removal and replacement.
8. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
9. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
10. Valves shall be located on all branches of water supply lines where shown on the Drawings. Position valves to facilitate access and operation.

3.02 FIELD QUALITY CONTROL

A. Site Tests:
1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
2. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
3. All piping shall be flushed or blown out after installation prior to testing.
4. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests.

CONTRACTOR shall provide all temporary sectionalizing devices and vents as required for testing.

5. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.
6. Test Requirements:

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
Potable Water	150	Water	"A"

7. Leakage allowance Designation "A" shall mean zero leakage for unburied pipe and shall be not more than 0.002 gallon per hour per inch diameter per 100 feet of buried pipe for compression or solder joint pipe.
8. Tests for all gravity sewers shall be as follows: Pipe will be plugged at its downstream end, and water will be placed inside the pipe to a minimum head of 10 feet. Water shall be held for 15 minutes without dropping. No leakage is allowed.

3.03 CLEANING AND DISINFECTION

A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line.

B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Lump Sum Bid. Copies of test results shall be submitted to OWNER and ENGINEER.

END OF SECTION

SECTION 15250

MECHANICAL INSULATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: All new cold and hot potable water, roof drains, water supply piping, and rigid chemical feed piping 3-inch diameter and smaller; located above ground, exposed to view or above suspended ceilings shall be insulated with preformed pipe insulation. All insulation damaged during construction shall be replaced in accordance with these specifications.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM E84–Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM C533–Specification for Calcium Silicate Block and Pipe Thermal Insulation.

1.03 SUBMITTALS

A. See Section 01300–Submittals for shop drawing submittal procedures.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Except as otherwise specified, insulation shall be manufactured by the following, or equal:
1. Schuller International, Inc.
2. Owens Corning.
3. Knauf.
4. Armstrong.
5. Mansville.

2.02 PIPE INSULATION

A. All pipe covering, jackets, duct insulation, vapor barriers, adhesive, and mastics shall have a flame spread rating of 25 or less and a smoke- developed rating of 50 or less in active return or supply air plenums. Insulation in all other areas within the building shall have a flame spread of 25 or less and a smoke-developed rating of 150 or less. Test method shall be ASTM E84.

B. Water Piping: All new hot and cold water piping (including PW, NPW, and PLW), fittings, valve bodies, and flanges shall be covered with 1-inch glass fiber (K-factor of 0.25 at 75°F mean), 1-inch molded phenolic (K-factor of 0.23 at 75°F mean), or 3/4-inch rigid urethane

(K-factor of 0.16 at 75°F mean) with all service jacket. Provide a PVC jacket for all exposed water piping.

C. Roof Drains: Roof drain bodies, horizontal roof leaders, and all associated storm water lines shall be covered with 1/2-inch flexible elastomeric pipe insulation (K-factor of 0.26 at 75°F mean).

D. Piping in Slabs and Walls: All new cold and hot water piping and nonpotable water inside concrete slabs or inside walls shall be insulated with Armstrong Armaflex II, or equal, 1/2-inch-thick.

PART 3–EXECUTION

3.01 INSTALLATION

A. All insulation shall be applied in strict accordance with the manufacturer's written recommendations.

B. All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation or with "Zeston"-type, pre-molded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8-ounce glass mesh and mastic (use breather mastic on systems operating above 50°F; a vapor barrier mastic on systems operating from 50°F down). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4-inch in from the lap edge on systems operating at 50°F and above; below 50°F and on roof drain lines, the laps are to be vapor sealed using self-sealing lap, lap-seal tape gun, or adhesive. All insulation ends are to be tapered and sealed regardless of service.

C. Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Pipe hangers are to be sized large enough to be installed over the outer surface of the insulation. Load distributing corrosion-resistant metal shields shall be installed around the lower 1/3 circumference of the insulation. For each pipe hanger, provide a half-round, 12-inch-long hanger block at the bottom half of the pipe in place of the fiberglass insulation. The blocks shall be molded foam glass insulation. Shields shall be 16 gauge. Shields shall be 12 inches long.

END OF SECTION

SECTION 15330

ABOVEGROUND FUEL STORAGE TANK

PART 1–GENERAL

1.01 SUMMARY

A. Provide an aboveground diesel fuel storage tank for use with the standby emergency generator.

1.02 RELATED WORK

A. Special requirements for equipment are included in Division 0 and 1 of the specifications.

B. The standby emergency generator is specified in Division 16, Section 16610.

1.03 SUBMITTALS

A. Complete shop drawings shall be submitted as specified in Section 01300. O & M Manuals shall be provided as specified.

PART 2–PRODUCTS

2.01 AVAILABLE MANUFACTURERS

A. Subject to compliance with the complete requirements of these Specifications, manufacturers offering products which may be incorporated into the work include the following: CONVAULT

2.02 ABOVEGROUND DIESEL FUEL STORAGE TANK

A. The diesel fuel storage tank shall be aboveground type consisting of a steel inner tank with a reinforced concrete secondary containment.

B. The diesel fuel storage tank shall have a capacity of 6,000 gallons. The tank shall be supplied with accessories required for standby generator fuel storage, including vent riser, 4-inch iron and brass lockable fill cap, 6-inch emergency vent, 4-inch gage stick, decal package, float gage, vent and suction tube package, double poppet foot valve on suction tube, and guillotine fill limiter with vent whistle.

C. Steel Primary Tank:
   1. The steel primary tank shall be listed by UL as an aboveground tank for flammable or combustible liquids and manufactured in accordance with U.L. – 142.
   2. The steel tank shall have "emergency vent" as required by NFPA 30 with no size reduction allowed for concrete encasement (insulation).
   3. The steel tank shall have a normal vent independent of the emergency vent as required by NFPA 30.
   4. The steel tank shall be threaded, except for leak detector tube. All tank openings shall be located in the top of tank.

5. The steel tank shall be rectangular in shape and have continuous welds on all sides, inside as well as outside.
6. The steel tank shall have a lug for connecting a ground conductor for lighting protection in accordance with NFPA 78.
7. The steel tank shall be pressure tested at 5 PSI per U.L. 142.
8. The outer surface of steel tank shall be covered by ¼ inch thick insulating spacer panels of polystyrene, or equally acceptable thermal insulation which melts on contact with leaking petroleum products.
9. Secondary containment shall consist of a 30 mil. polygeomembrane, or equally acceptable material, enclosing the polystyrene spacer panels and the steel tank.
10. No steel or insulating spacer panels in unit shall come in direct contact with concrete or any other corrosive material with the exception of tank top openings.
11. Steel tank and secondary containment shall be encased in homogenous layer of 4,000 psi reinforced concrete 6-inches thick to create a protected (vaulted) tank with no penetrating metal elements except at the top.
12. The steel tank shall be pressurized to 5 psi at the casting facility and shall remain pressurized until concrete sets, to provide expansion space between concrete and steel tank during use. This is in addition to the test required for U.L. 142 (#6 above).
13. The steel tank shall have an integral five to seven gallons spill containment system, U.L. – listed as a part of the tank, with internal reservoir and normally closed U.L. – listed drain port.

D. Protected Tank:
1. The protected (vaulted) tank shall have capability of physical monitoring between primary and secondary containment.
2. The protected (vaulted) tank shall have a two-hour fire rating in accordance with appendix II-F of the 1991 uniform fire code.
3. Concrete encasement (insulation) shall be of a monolithic (seamless) pour and contain no cold joints or direct (heat-transfer) connections between the steel and the outside face of the concrete encasement on bottom or sides.
4. The protected (vaulted) tank shall have appropriate warning signs as required by the local jurisdiction.
5. The protected (vaulted) tank shall have an exterior light reflecting and weather resistant acrylic or epoxy coating.
6. The vault shall be ballistic impact resistant.
7. The vaulted tank design shall have been in manufacturing production and commercial use for a minimum of seven years.

E. The fuel storage tank shall be in full compliance with E.P.A. 40CFR112 with a fill limiter or warning device installed.

F. The tank shall be tested in accordance with U.L. 2085 – insulated aboveground tanks for flammable liquids.

PART 3–EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall install the fuel storage tank in compliance with the manufacturer's recommendations, and in compliance with local codes.

B. The CONTRACTOR shall provide 3,000 gallons of diesel fuel for initial generator start-up and testing.

END OF SECTION

SECTION 15400

PLUMBING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. All material and piping for plumbing.
   2. Concrete foundations and anchor bolts for all equipment furnished under this section.
   3. Piping connections to all plumbing equipment, whether furnished under this section or not.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials shall be National Sanitation Foundation (NSF)-approved.

2.02 PLUMBING PIPING AND APPURTENANCES

A. Unless otherwise specified, piping shall be in accordance with Section 15040–Piping and Accessories.

2.03 PLUMBING SPECIALTIES

A. Unless otherwise specified, valves shall be provided in accordance with Section 15040–Piping and Accessories.

B. Floor Drains:
   1. (FD-1) Floor drains in finished areas or tiled areas shall be Zurn Z-400, Type H, Wade Model AX6, or equal, with 6-inch round adjustable strainer top with integral clamping frame and secured heel-proof grade. Provide polished nickel bronze top.
   2. (FD-2) Floor drains for piping 4 inches and under shall be Zurn Z-551, Wade W-1300, or equal, and for piping larger than 4 inches Zurn Z-505, Wade W-1240, or equal. Drains receiving pump drainage piping shall be provided with Zurn Z-329, Wade EG-8, funnel converter assembly, or equal.
   3. Drains receiving engine drainage and labeled equipment drains (ED) shall include funnel converter assembly Zurn Z-329, Wade EG-8, or equal. Cut hole in grate or base of funnel.

C. Cleanouts:
   1. Manufacturers shall be Zurn, Wade, Smith, Josam, or equal.

2. Each cleanout shall be gas and watertight.
3. Cleanouts that are elevated shall include a membrane flashing flange to prevent leakage to the lower floor.
4. Interior Concrete Floor Areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
5. Interior Ceramic Tile Floor Areas: Enameled cast iron body with square adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400-T.
6. Interior Vinyl Tile Floor Areas: Enameled cast iron body with round adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
7. Exterior Paved Areas: Cast iron hub or plug with tapered threaded ABS or PVC closure plug, cast iron frost sleeve and cover set in 24-inch-square by minimum 4-inch-thick reinforced concrete pad top or surrounding pavement, crowned for drainage. Neenah R-1976 with nonferrous securing screw.
8. Exterior Unpaved Areas: Cast iron hub or plug with tapered threaded ABS or PVC closure plug, cast iron or PVC frost sleeve and cover set in 24-inch-square by minimum 4-inch-thick reinforced concrete pad top. Neenah R-1976 with nonferrous securing screw.

2.04 PLUMBING EQUIPMENT

A. Sump Pumps:

1. Furnish and install complete Hydromatic, or equal, sump pump system(s) as shown on the Drawings and summarized below. The complete system shall include pumps, electric controls, level controls, and all accessories.

Pump No.	HP	Capacity (gpm)	TDH (ft)	Discharge Diameter
P-101	1/4	20	20	1 1/2 inches

2. The motor shall be submersible-type, ball bearing design, oil-filled and protected with manual reset thermal-type overload. Motor housing shall be filled with dielectric pure, clean, insulating oil. Motor shall have precision mechanical seal to prevent leakage into the housing. Seal faces shall be carbon and ceramic, super lapped for long leak-proof life. The motors shall be single phase, 60 cycle, 120 volts for operation at 1,750 rpm. Power cord and float switch cords shall be provided in lengths adequate to reach the control panel as provided by pump manufacturer and as shown on the Drawings.
3. All pumps shall be heavy-duty-type with cast iron housing. Impeller shall be constructed of cast iron of the nonclog-type, passing minimum 2-inch solids. All fasteners shall be of stainless steel. Discharge piping from each pumps and shall include one flexible connector, two check valves, and one gate valve for each pump as shown on the Drawings.
4. A NEMA 4X control panel with controls as indicated below shall be furnished. Panel shall include a non-fused, main disconnect with interlock to prevent opening the panel with switch in "On" position. A defeater shall be provided to bypass this interlock, with handle lockable in "Off" position. Control wiring inside the panel shall be insulation type THHN, minimum size 16 AWG. The control panel shall include combination starters for the pump, circuit breakers for the pump, H-O-A switches, green "Run," and red "Fail" push-to-test indicating lights for the pump, elapsed time meters, and red "HWL" push-to-test indicating light. All devices shall be installed on a control panel hinged inner door. Level sensing shall be by mercury-free float switches, one each for

pump ON, one for pump OFF and one for HWL alarm at each station provided. There shall be an auxiliary contact from the HWL alarm signal for remote indication at the SCADA.

5. Cover shall ensure airtight seal between the sump and atmosphere. Pump discharges, 3-inch vent, level control, and power cables shall enter the sump through the side of the sump. The openings in the sump shall be sealed with a mechanical seal.
6. All electrical controls shall be installed under Division 16, including those items specified to be furnished with the equipment. All electrical equipment and controls specified to be furnished with the equipment shall comply with the requirements of Division 16.

PART 3–EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified, installation of piping shall be in accordance with Section 15040–Piping and Accessories.

B. Plumbing system shall be installed with hangers and supports in accordance with the Plumbing Code. Insulation saddles shall be used at supports of insulated piping.

C. Plumbing system shall be installed in accordance with local plumbing requirements and applicable portions of the Kentucky Building Code. Where requirements conflict, the stricter standard shall apply.

D. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the General Contractor.

E. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.

F. Start-up and test equipment adjusting operating and safety controls for proper operation.

G. Lubricate pumps before start-up. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of operation.

H. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

3.02 FIELD QUALITY CONTROL

A. Unless otherwise specified, testing shall be in accordance with Section 15040–Piping and Accessories.

B. Building drainage systems shall be tested and inspected in accordance with local requirements and the 2002 Kentucky Building Code.

END OF SECTION

SECTION 15535

REFRIGERANT PIPING AND SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Refrigerant piping.
   2. Refrigerant.
   3. Refrigeration specialties.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ARI 710–Liquid Line Dryers.

B. ARI 730–Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers.

C. ARI 750–Thermostatic Refrigerant Expansion Valves.

D. ASHRAE 15–Safety Code for Mechanical Refrigeration.

E. ASHRAE 34–Number Designation of Refrigerants.

F. ASME B31.5–Refrigeration Piping.

G. ASME SEC 8D–Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.

H. ASTM B88–Seamless Copper Water Tube.

I. ASTM B280–Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

J. UL 429–Electrically Operated Valves.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Shop Drawings: Indicate schematic layout of system including equipment, critical dimensions, and sizes.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products in accordance with manufacturer's recommendations.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, and seal prior to shipment until connected into system.

PART 2–PRODUCTS

2.01 PIPING

A. Refrigeration piping shall be ASTM B88, Type L, hard tempered refrigeration grade copper tubing with original mill caps when delivered to site.

B. Fittings shall be wrought copper sweated-type.

2.02 REFRIGERANT

A. Refrigerant shall be R-22: Monochlorodiflouromethane in accordance with ASHRAE 34.

2.03 REFRIGERANT SPECIALTIES

A. Acceptable manufacturers are Sporlan, Alco, or equal.

B. Provide all necessary accessories for the system to perform as recommended by the equipment manufacturer.

C. Accessories shall include but not limited to strainers, filter/dryers, solenoid valves, thermal expansion valves, evaporator back pressure valves, constant pressure expansion valves, shutoff valves, sight glass with caps, and charging connections.

PART 3–EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

C. Flood piping system with nitrogen when brazing.

D. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

E. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

A. Refrigeration system shall be tested in accordance with ASME B31.5.

END OF SECTION

SECTION 15671

AIR-COOLED CONDENSING UNITS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Air-cooled condensing units.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ARI 210/240–Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. ARI 270–Sound Rating of Outdoor Unitary Equipment.

C. ASHRAE 15–Safety Code for Mechanical Refrigeration.

D. UL 207–Refrigerant-Containing Components and Accessories, Nonelectrical.

E. UL 303–Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

1.03 SUBMITTALS

A. Submit under provision of Section 01300–Submittals.

1.04 QUALITY ASSURANCE

A. Unit performance shall be certified in accordance with ARI Standards.

B. Manufacturer shall be the same as the manufacturer of the air handling unit specified in Section 15855.

1.05 DELIVERY, STORAGE AND PROTECTION

A. Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturer is Trane, or equal.

B. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

2.02 AIR-COOLED CONDENSING UNIT

A. Unit shall be a self-contained, packaged, factory-assembled and pre-wired air-cooled condensing unit suitable for outdoor use. Unit shall consist of casing, coils, fans, compressors, and controls as indicated on equipment schedule.

B. Casing shall provide a fully weatherproof enclosure for outdoor installations. Construction shall be galvanized steel with baked enamel finish. Provide removable access panels for service access and openings for power and refrigerant connections.

C. Condenser coils shall have aluminum fins mechanically bonded to seamless copper tubing. Provide subcooling circuits.

D. Condenser fans shall be vertical discharge direct driven propeller-type with fan guard on discharge.

E. All motors shall be suitable for outdoor use or weather protected with permanent lubricated ball bearings and thermal overload protection.

F. Compressors shall be of serviceable hermetic design with external spring isolators. Compressors shall unload based on suction pressure down to 33% of full capacity for partial load operation. Provide factory-installed crankcase heater.

G. Unit shall be provided with refrigerant tubing and charge, liquid and suction shutoff valves, and all refrigerant specialties for complete installation. See Section 15535–Refrigerant Piping and Specialties for refrigerant piping and specialties.

H. All controls shall be factory-wired and located in a separate enclosure. Controls shall include high- and low-pressure cutouts, compressor overload cutout, antishort cycle timer, and low ambient controls to allow operation down to -20°F. All required control power and other transformers shall be factory-furnished and installed.

I. Manufacturer shall provide factory-wired and installed NEMA 3R equipment disconnect mounted exterior to the unit and within sight.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. All electrical wiring and interconnections shall be furnished and installed as a part of Division 16.

C. Provide connection to refrigeration piping system and evaporators. Refer to Section 15535–Refrigerant Piping and Specialties.

END OF SECTION

SECTION 15855

AIR HANDLING UNITS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Air source heat pump (ASHP).

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ARI 430–Central Station Air Handling Units.

B. ASHRAE 15–Safety Code for Mechanical Refrigeration.

C. NFPA 70–National Electric Code.

D. NFPA 90A.

E. UL900–Test Performance of Air Filter Units.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

1.04 QUALITY ASSURANCE

A. Unit performance shall be certified in accordance with ARI Standard 430 for Central Station Air Handling Units.

B. Direct-expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.

C. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled in accordance with the unit manufacturer's instructions.

PART 2-PRODUCTS

2.01 AIR SOURCE HEAT PUMP (ASHP)

A. Acceptable manufacturers is Trane, or equal.

B. General:
1. The unit will be horizontal flow as shipped with the option for converting to downflow.
2. Unit shall be factory-assembled, piped, internally wired, and fully charged with R-22.
3. Unit shall be UL-listed and have a UL label.
4. Cooling performance shall conform to ARI standards.

C. Unit Construction:
1. All components shall be mounted in a weather-resistant steel cabinet with enamel finish.
2. Access panels shall be provided for unit controls, indoor coil, and fans.
3. Indoor air section compartment shall be completely insulated with fireproof, permanent, odorless glass fiber material.
4. Knockouts will be provided for utility and control connections.
5. Drain connections shall be provided to accommodate indoor water runoff.

D. Refrigeration System:
1. Compressor shall be hermetically sealed, high-efficiency-type with internal overcurrent, overtemperature protection, internal pressure relief, and crankcase heater.
2. Units shall have capillary tube refrigerant control and a thermal expansion valve for heating. Provide service pressure tap ports and a refrigerant line filter dryer.
3. Outdoor fan shall be direct drive, statically and dynamically balanced propeller fan used in a vertical discharge, draw through configuration. Motor will be permanently lubricated with overload protection.

E. Indoor fan shall be multispeed, direct drive, forward-curved blower, permanently lubricated, with overload protection.

F. Provide antishort cycle timer set at five minutes off between compressor cycles.

G. Air handler unit shall be utilized with air cooled condensing unit specified in Section 15671.

H. Provide programmable night setback thermostat with 7-day programming capability.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with drawings and manufacturer's recommendations.

B. Pipe and trap condensate to building exterior in accordance with Section 15400–Plumbing.

C. Furnish and install neoprene vibration isolators sized by the manufacturer.

D. Wiring and interconnection to be provided by Division 16.

E. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

F. Provide flexible duct connections between all ductwork and unit.

3.02 CLEANING

A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER.

END OF SECTION

SECTION 15860

CENTRIFUGAL FANS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Centrifugal roof exhaust fans.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. AMCA 99–Standards Handbook.

B. AMCA 210–Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300–Test Code for Sound Rating Air Moving Devices.

D. AMCA 301–Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. NFPA 70–National Electrical Code.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

1.04 QUALITY ASSURANCE

A. Fans shall bear AMCA certified rating seals.

1.05 DELIVERY, STORAGE AND HANDLING

A. All fans shall be stored and handled in accordance with manufacturer's instructions.

B. Motors, shafts, and bearings shall be protected from weather and dust.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers are Greenheck, Cook, or equal.

B. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs

for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

2.02 CENTRIFUGAL ROOF EXHAUST FANS

A. Centrifugal roof exhaust fans shall be belt drive, roof curb, bird screen, motorized control dampers, and disconnect. Fan performance shall be as indicated on drawing schedules. Fans shall be UL listed. Dampers shall meet requirements of Section 15980–Temperature Controls and Instrumentation.

B. Fan housing shall be aluminum with all fasteners either aluminum or stainless steel.

C. All fan wheels shall have backward-inclined or forward-curved blades, and the fan wheels shall be statically and dynamically balanced.

D. The entire drive assembly shall be mounted on neoprene vibration isolators to provide quiet, vibration free operation. Fan performance shall include AMCA-certified air and sound ratings, and fans shall bear the AMCA seal.

E. The fan motor shall be totally enclosed, fan-cooled, and shall be NEMA approved. CONTRACTOR shall provide run contactors for single phase fans. Three phase starters shall be provided as a part of Division 16. Manufacturer shall provide a factory-prewired NEMA 3R disconnect accessible without removing fan shroud. Toggle switches are not allowed.

F. The fan shaft shall be mounted in prelubricated, sealed ball bearing pillow blocks. Bearings shall be rated for 200,000 hours. Belt drives shall have an adjustable motor plate for belt tensioning. The motor and drives shall be mounted out of the air stream.

G. Provide an aluminum bird screen on the fan's discharge.

H. Manufacturer shall furnish a prefabricated, insulated roof curb with wood blocking to level curb on roof. The roof curb insulation shall be 1 1/2-inch-thick, 3 pounds per cubic foot rigid fiberglass board. Curb height shall be nominal 12 inches unless otherwise indicated. For fans on pitched roof, manufacturer shall furnish a pitched cricketed roof curb.

I. Provide baked enamel finish. Color to be selected by OWNER. Submit color chart with shop drawings.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and drawings.

B. CONTRACTOR to provide all mounting hardware and accessories necessary to complete installation.

C. Provide flexible duct connections on inlet and outlet of all fans.

D. Drawings are based on the scheduled fan make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

SECTION 15865

AXIAL FANS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes:
   1. Sidewall propeller fans.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. AMCA 99–Standards Handbook.

B. AMCA 210–Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300–Test Code for Sound Rating Air Moving Devices.

D. AMCA 301–Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. NFPA 70–National Electrical Code.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

1.04 QUALITY ASSURANCE

A. Fans shall bear AMCA-certified rating seals.

1.05 DELIVERY, STORAGE, AND HANDLING

A. All fans shall be stored and handled in accordance with manufacturer's instructions.

B. Motors, shafts, and bearings shall be protected from weather and dust.

PART 2–PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers are Greenheck, Cook, or equal.

B. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

2.02 SIDEWALL PROPELLER FANS

A. Provide a complete belt drive, sidewall, propeller exhaust fan with wall mount collar, starter, and disconnect. Provide an OSHA-approved fan guard provided by fan manufacturer. Fans shall be UL listed.

B. Fans shall be six-bladed axial-type. Propellers shall be die-formed galvanized steel riveted to a steel hub. Propellers shall be statically and dynamically balanced.

C. Fan shaft shall be ground, polished, and mounted in permanently lubricated sealed, pillow block bearings. Bearings shall be rated for 200,000 hours at maximum speed.

D. Fan panel shall have prepunched mounting holes, formed flanges with welded corners, and a deep-formed venturi. Panel shall be one-piece galvanized steel.

E. Motor shall be NEMA-approved ball bearing-type. Drive shall be sized for 150% of driven horsepower and shall have adjustable sheaves for final balancing. Pulleys shall be machined cast iron. Manufacturer shall furnish a NEMA 3R equipment disconnect. CONTRACTOR shall mount disconnect exterior to unit and within sight.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and drawings.

B. CONTRACTOR to provide all mounting hardware and accessories necessary to complete installation.

C. All electrical wiring and interconnection shall be provided as a part of Division 16.

D. Drawings are based on the listed fan make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.

END OF SECTION

SECTION 15890

DUCTWORK

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Metal ductwork.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ASTM A36–Structural Steel.

B. ASTM A90–Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

C. ASTM A167–Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A480–General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

E. ASTM A653–Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A527–Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

G. ASTM B209–Aluminum and Aluminum-Alloy Sheet and Plate.

H. AWS D9.1–Welding of Sheet Metal.

I. NBS PS 15–Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

J. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

K. NFPA 90B–Installation of Warm Air Heating and Air Conditioning Systems.

L. SMACNA–HVAC Air Duct Leakage Test Manual.

M. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

N. UL 181–Factory-Made Air Ducts and Connectors.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

1.04 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700–Contract Closeout.

B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

1.06 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain recommended minimum temperatures during and after installation of duct sealants.

PART 2–PRODUCTS

2.01 MATERIALS

A. All sheet metal used for construction of duct shall be 24 gauge or heavier.

B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating in conformance with ASTM A90, A653.

C. Aluminum ducts shall be ASTM B209; Type 3003-H14 aluminum.

D. Insulated flexible ductwork shall be Atco, or equal. Atco 70 Series, or equal, with 1 1/2-inch, 3/4-pound density fiberglass insulation, reinforced polyester or foil-type vapor barrier, polyester or vinyl film with bonded helix core liner, and zinc-coated high carbon steel helix. Thermal conductance not to exceed 0.23, and working pressure rating shall be a minimum of 6 inches of water. All items to comply with UL-181, NFPA 90A, and 90B. Flame Spread–25 maximum, Smoke Development–50 maximum.

E. Stainless Steel Ducts: ASTM A240/A240M and A480/A480M, Type 304 or 316 as indicated on Drawings.

F. All fasteners shall be 316 stainless steel unless otherwise indicated.

G. Duct sealant shall be United McGill United Duct Sealer, or equal, for indoor applications and United McGill Uni-Weather, or equal, for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.

H. Hanger rod shall be ASTM A36 galvanized steel or 316 stainless steel for ducts other than galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK FABRICATION

A. Field and Shop Fabricated Ductwork (Rectangular):
   1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible. Provide duct material, gages, reinforcing, and sealing in accordance with SMACNA Standards for 2-inch static rating, 2,500 fpm velocity, and duct seal Class A.
   2. Construct Ts, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 15910 -Ductwork Accessories.
   3. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
   4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets unless otherwise detailed.

B. Manufactured Ductwork and Fittings (Round and Flat Oval):
   1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
   2. Ductwork shall be United McGill Uni-Seal, or equal, fabricated spiral seam round or spiral seam flat oval where shown on Drawings. Material and sizes shall be as indicated on the Drawings.
   3. Ductwork shall be constructed with lock-tight spiral grooved seams, gored elbows with centerline radius of 1 1/2 times the duct diameter, and male/female fittings. Conical tees, conical 45° laterals, conical bellmouth taps, and fittings shall be used. Seal all joints air-tight with gaskets and sealants per SMACNA.
   4. Where grilles and registers are shown to be tapped into ductwork sides, the entire assembly including the round duct section and the rectangular tap shall be fully welded and provided by the manufacturer.
   5. Ductwork construction, sheet metal gauges, sealant, reinforcing, joints, accessories, spiral seams, hangers, and bracing shall be in accordance with SMACNA Standards for 2-inch to 10-inch static pressure rating, 4,000 fpm velocity, and duct seal Class A.
   6. Double-wall insulated round and flat oval ducts shall be United McGill Acouti-k27, or equal. Ductwork shall be spiral lockseam duct with solid outer wall, 1-inch-thick fiberglass insulation, perforated inner wall. Outer and inner wall materials shall be as indicated on Drawings with sheet metal gauges per SMACNA.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible.

C. Duct sizes are inside clear dimensions. For lined or double-wall ducts, maintain sizes inside lining.

D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross section, offsets, etc., to avoid interference with other equipment and supports.

F. Use double nuts and lock washers on threaded rod supports.

G. Exposed ductwork shall be painted per Division 9–Finishes.

H. Connect air diffusers, registers, and grilles to supply and return ducts directly, unless flexible ductwork is specifically indicated on the Drawings. Where registers and grilles are to be mounted on exposed ductwork, provide flanged opening for finished appearance.

I. For flexible ductwork, follow manufacturer's installation instructions with particular attention to fully extending duct. Ducts shall be supported to prevent sags in excess of 4 inches in 10 feet. No more than one long turn (radius = 1 1/2 × diameter) will be allowed in any single run. Use round sheet metal stub ducts with conical bell mouth inlet and damper attached to trunk or branch duct for starting flexible duct run and provide insulated guard. Furnish and install a rigid elbow at the inlet to each diffuser of same diameter as flexible duct. Steel strap clamp bands or plastic draw bands with self-lock may be used for connection of flexible ducts to other materials. Maximum duct lengths shall be 6 feet for any runout.

J. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

K. Provide an experienced installer to go through the air distribution system with the balancer.

L. Any modifications to the ductwork shown on the Drawings must be approved by ENGINEER prior to installation. Any changes in the ductwork layout not approved by ENGINEER affecting static pressure shall be the responsibility of CONTRACTOR to modify air handling equipment at no additional cost to OWNER.

END OF SECTION

SECTION 15910

DUCTWORK ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Air turning devices.
   2. Backdraft dampers.
   3. Duct access doors.
   4. Duct test holes.
   5. Flexible duct connections.
   6. Volume control dampers.
   7. Duct screens.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

B. SMACNA–HVAC Duct Construction Standards–Metal and Flexible.

C. UL 33–Heat Responsive Links for Fire-Protection Service.

D. UL 555–Fire Dampers and Ceiling Dampers.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

1.04 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700–Contract Closeout.

B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

PART 2–PRODUCTS

2.01 AIR TURNING DEVICES

A. Provide factory-fabricated metal air turning vanes in all square elbows and bends per SMACNA Standards. Turning vanes shall be constructed of the same material specified for the ductwork. Where ductwork is lined, provide perforated airfoil blades filled with glass fiber insulation.

2.02 BACKDRAFT DAMPERS

A. Provide multiblade, parallel gravity, self-acting, backdraft dampers where indicated. Dampers shall be heavy-duty with 16 gauge galvanized steel frame, ball bearings, and 20 gauge, 6-inch maximum aluminum blades. Unit shall be rated for 3,000 fpm face velocity.

2.03 DUCT ACCESS DOORS

A. Provide Ductmate, or equal, duct access doors equal to Ductmate Model FD&H for galvanized ductwork. Access door hinge and cover shall be constructed of material similar to that specified for ductwork. Provide insulated access doors where ductwork is insulated.

2.04 DUCT TEST HOLES

A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps.

2.05 FLEXIBLE DUCT CONNECTIONS

A. All ductwork shall be isolated from fans, fan enclosures, etc., with flexible connections. Provide connections to air handling equipment (except as noted), with Ventfabrics, Inc., "Ventglass," or equal, neoprene coated glass fabric with a metal-to-metal gap of approximately 6 inches.

2.06 DUCT SCREENS

A. Provide metal screens, equal to Ryerson Ryex Standard, 3/4-inch, 12 gauge sheet metal with border frame for protection on open duct inlets and outlets and as indicated on the drawings. Frame and screen shall be of similar material to ductwork.

B. Control Dampers:
   1. Dampers shall be Greenheck Model VCD-23, or equal, low leakage control damper with galvanized steel construction.
   2. Dampers for open/closed control shall be parallel blade and modulating damper shall be opposed blade.
   3. Damper frame shall be 16 gauge. Dampers shall have extruded vinyl blade edge seals, flexible metal compression-type jamb seals, nylon bearings, and solid stops. Dampers shall be rated at a leakage of less than 10 cfm per square foot at 4 inches of water column pressure differential.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards–Metal and Flexible. Refer to Section 15890–Ductwork for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access and as indicated.

D. Provide duct test holes as necessary for testing and balancing purposes.

E. Provide fire dampers at locations indicated and where ducts and outlets pass through fire rated components. Install with perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings, and hinges.

F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

G. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts for air balancing and where indicated on the drawings. Install minimum two duct widths from duct takeoff.

H. Provide balancing dampers on duct take-off to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Diffusers and grilles.
   2. Louvers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ADC 1062–Certification Rating and Test Manual.

B. AMCA 500–Test Method for Louvers, Dampers, and Shutters.

C. ARI 650–Air Outlets and Inlets.

D. ASHRAE 70–Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. NFPA 90A–Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

A. Submit under provisions of 01300–Submittals.

1.04 QUALITY ASSURANCE

A. Performance of air terminals shall be in accordance with ADC 1062.

B. Louvers shall be tested and certified in accordance with AMCA 500 and shall bear the AMCA seal.

PART 2–PRODUCTS

2.01 DIFFUSERS AND GRILLES

A. Acceptable manufacturers are Carnes, Price, or Metalaire. Submit standard color chart with shop drawings for selection by OWNER.

B. Ceiling supply diffusers for lay-in ceilings shall be Carnes Model SFAB, or equal. Diffusers shall be fixed aluminum stamped-type with round neck duct connection.

C. Eggcrate-type return, transfer, and exhaust grilles for lay-in ceilings shall be Carnes model RAPB, or equal. Grilles shall be full-face eggcrate with 1/2-inch by 1/2-inch by 1/2-inch aluminum core and frame. Duct connection shall be round neck duct connection.

D. Slot diffusers shall be Carnes model DFSA, or equal. Diffuser plenum shall be lined with 1/4-inch 3 pcf density fiberglass matte-faced insulation with round duct inlet connection.

E. Return, exhaust, and transfer grilles for sidewall and surface mounting shall be Carnes model RSLA, or equal. Grilles shall be steel construction with 45° horizontal louvered blades.

F. Stainless steel return, exhaust, and transfer grilles for sidewall and surface mounting shall be Carnes Model RLAB, or equal. Grilles shall be 304 stainless steel construction with 45° horizontal louvered blades.

G. Drum louvers shall be Carnes model RAWA, or equal. Door grille shall be double-side mounting of heavy-duty steel construction with tamper-proof screws.

H. Door grilles shall be Carnes model RGCA, or equal. Door grille shall be double-side mounting of heavy-duty steel construction with tamper-proof screws.

I. Supply grilles for sidewall and surface mounting shall be Carnes model RSDB, or equal. Grilles shall be steel construction with double deflection blades.

J. Stainless steel supply grilles for sidewall and surface mounting shall be Carnes model RLDB, or equal. Grilles shall be 304 stainless steel construction with double deflection blades.

2.02 LOUVERS (EXTRUDED ALUMINUM)

A. Acceptable louvers are Greenheck ESD 603, or equal. See Drawing for sizes and locations.

B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08-inch thickness. Blades shall be 45° drainable-type spaced at 6 inches on center. Louver shall be capable of a velocity of 1,250 fpm with no water penetration. Performance shall include AMCA-certified air and moisture penetration data and louver shall bear the AMCA seal. Vertical and horizontal mullions and connections between panels shall not be exposed.

C. Provide channel frame, unless noted otherwise on the Drawings.

D. Provide aluminum insect screen on backside of louver. All fastenings shall be stainless steel or aluminum.

E. Louvers shall be furnished with Kynar finish, with custom color selected by OWNER. Submit standard color chart with shop drawings.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install diffusers, grilles, and registers in locations shown on Drawings and in accordance with manufacturer's recommendations.

B. Clean surface of diffusers, grilles, and registers after installation.

C. Install louvers in accordance with manufacturer's recommendations and drawing details.

END OF SECTION

SECTION 15980

TEMPERATURE CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Electrical components.
   2. Thermostats.
   3. Dampers and actuators.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit under provision of Section 01300–Submittals.

B. Submittal shall include control schematics with wiring and logic diagrams in addition to equipment information. All wiring shall be color coded and labeled at each end with corresponding numbers in accordance with 15195–Equipment Identification. This numbering shall be shown on the shop and record drawings.

1.03 QUALITY ASSURANCE

A. Temperature control equipment including panels and other standard marketed apparatus shall bear the nameplate of the manufacturer. The entire system including temperature control wiring shall be installed by mechanics employed by or under contract to the temperature control provider, a factory-licensed distributor, or factory-licensed dealer. The provider shall be responsible for the quality and satisfactory operation of all materials.

B. All control panels shall bear a serialized UL label.

C. Comply with the National Electric Code (NFPA 70) and any and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

PART 2–PRODUCTS

2.01 ELECTRICAL COMPONENTS

A. Provide electrical work in accordance with Division 16. All line voltage wiring and conduit shall be provided by Division 16 Contractor. All low voltage wiring (100 volts and below) shall be provided by temperature controls contractor and be installed in raceways provided by Division 16 Contractor.

B. Provide all components necessary to complete the work of this section including, but not limited to relays, transformers, motors, solenoid valves, starters, switches, override

controls, operator linkages, and associated low voltage wiring. Outdoor wiring and equipment shall be NEMA 4X, or as indicated.

C. All relays, time clocks, transformers, motors, operator linkages, wiring, etc., not specifically mentioned herein but necessary to make the control system complete and operative in accordance with the sequence of operation shall be provided as part of this section.

D. All boxes for thermostats shall be provided by Division 16 Contractor.

E. All control and auxiliary relays shall have indicating LEDs.

F. Pushbuttons shall be heavy-duty, oil-tight, 30 mm, flush head-style.

G. Indicating lights shall be heavy-duty, oil-tight, 30 mm, push-to-test-type.

H. Selector switches shall be heavy-duty, oil-tight, 30 mm.

2.02 THERMOSTATS

A. Line voltage thermostats for single stage heating or single stage cooling shall be Honeywell T6051A. Line voltage thermostats for single stage heating or single stage cooling in NEMA 4X areas shall be Honeywell T631F.

B. Line voltage thermostats for two stage heating, two stage cooling, or one heating and one cooling stage shall be Honeywell T6052.

C. Programmable thermostat shall be Honeywell T7300 thermostat and Q7300 subbase. The thermostat shall have occupied/unoccupied setpoints with overrides, auxiliary contacts as specified, and be fully programmable (7-day) with battery backup.

2.03 DAMPERS AND ACTUATORS

A. Outside Air Intake and Exhaust Outlet:
   1. Dampers shall be TAMCO Series 9000, or equal, thermally insulated control damper with aluminum construction. Dampers shall be parallel blade.
   2. Extruded aluminum (6063T5) damper frame shall not be less than 0.080-inch thickness. Damper frame to be 4 inches deep and shall be insulated with polystyrene on four sides. Damper shall be rated at a leakage of less than 4.0 cfm per square foot at 4.0-inch of water column pressure differential.
   3. Blades to be extruded aluminum (6063T5), internally insulated with nonCFC, expanded polyurethane foam, and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
   4. Blade gaskets shall be extruded EPDM; blade seals shall be extruded TPE.
   5. Shaft to actuator shall be hex-type, material to match damper construction.

B. Actuators:
   1. Actuators shall be Belimo AF 120-S, or equal, with auxiliary switch rated for 133-inch/lb of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified.

2. Generator associated intake and exhaust dampers shall be power-to-close and spring-to-open on power fail.
3. All actuators shall be direct-coupled to damper and mounted outside the air stream.
4. Remove additional appliance cord if auxiliary switch is not used.
5. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install all equipment in accordance with manufacturer's recommendations and Division 16.

B. Coordinate location of exposed devices prior to rough-in. Thermostats shall be mounted where shown on the Drawings.

C. Temperature controls to be installed in or on insulated ductwork shall be installed after the insulation has been applied.

D. Thermostats shall be mounted 4 feet above floor to centerline, unless otherwise noted. Notify ENGINEER of conflicts.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1–GENERAL

1.01 GENERAL

A. Work Included:
   1. Balancing air systems.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit under provisions of Section 01300–Submittals.

B. Prior to final balancing, submit a final report which includes the following information.
   1. For each supply, return and exhaust register, and ceiling outlet:
      a. Room number.
      b. Type of register and outlet and catalog size.
      c. Air flow factor.
      d. Design CFM and velocity.
      e. Actual CFM and velocity.
      f. Percent of design CFM.
      g. Room pressure relationship.
   2. For each fan and pump:
      a. Unit number.
      b. Fan size and wheel type (Pump size and impeller).
      c. Motor horsepower.
      d. Motor nameplate voltage and amps.
      e. Design CFM and static pressure (total pressure) (Pump GPM and head).
      f. Actual CFM and static pressure (total pressure) (Pump GPM and head).
      g. Actual fan RPM (Pump RPM).
      h. Actual motor voltage and amps (each phase).
   3. For piping: For piping system, record water flow through all equipment and inlet and outlet water pressure at each pump together with motor nameplate and actual current.

C. Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. Provide recommendations for correcting unsatisfactory performances, and indicate whether modifications required are within the scope of the contract, are design-related, or installation-related. List instrumentation used during testing, adjusting, and balancing procedures.

1.03 QUALITY ASSURANCE

A. Obtain services of an independent testing organization to perform testing and balancing work. The criteria for determining qualifications shall be membership in the Associated Air Balance Council (AABC), or certification by the National Environmental Balancing Bureau

(NEBB), or the testing organization shall submit proof that the organization meets standards for membership in AABC.

PART 2–PRODUCTS

2.01 BALANCING EQUIPMENT

A. CONTRACTOR shall have the following minimum equipment for balancing systems:
   1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
   2. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
   3. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
   4. Contact pyrometer 0-300°F range.
   5. Amprobe model RS-3, or equal.
   6. Calibrated pressure gauge (0-100 feet water head).
   7. Inclined manometer 0-30 inches of water.
   8. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
   9. Instruments shall be applied in accordance with manufacturer's instructions.

B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

PART 3–EXECUTION

3.01 PRELIMINARY REPORT

A. Provide an experienced installer to check the air distribution system for completion to be sure that the test openings and volume dampers indicated on the drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly, and that the system is ready for balancing. Add test openings, volume dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

3.02 ROOM AIR PRESSURE RELATIONSHIPS

A. The balancing contractor shall pay special attention to specific room pressure relationships specified. Rooms indicated to be positive or negative shall be balanced such. Rooms indicated to be positive shall have 10% more supply air than return/exhaust air quantities. Rooms indicated to be negative shall have 10% more exhaust than supply air quantities. The balancing contractor shall adjust and change fan drives to provide this feature regardless of plan air quantities noted on drawings.

3.03 METHOD OF AIR BALANCE (CONSTANT VOLUME SYSTEMS)

A. Prepare balancing sheets tabulating air quantities, unit areas, correction factors, and calculated air velocities required for each terminal system. For procedures not specified, follow AABC. Balancing shall be completed with all doors closed.

B. Adjust total air quantity to 110% of design, as measured by duct traverse, by adjusting fan speeds or branch duct volume dampers.

C. Read and record on the balance sheets the air velocities and volumes obtained. (Do not change any volume dampers while reading and recording.)

D. If air quantities are not within 10% of design values, readjust the duct terminal dampers to proportion the air.

E. Adjust the fan speed or the branch duct damper to adjust the air volume and then reread and record.

F. Immediately after completion of the final round, measure the total pressure in the duct and record on the balance sheet.

G. Adjust register, dampers, etc., to equalize the air volume between outlets, and adjust air pattern on supply outlets to produce the correct air pattern.

H. Repeat the above for each branch duct system.

I. Proportion the air flow for each branch duct system by adjusting the branch duct volume dampers using a pitot tube traverse or the total pressure reading recorded above.

J. Adjust the fan speed to deliver or exhaust the required air volume when the automatic dampers are placed in the 100% outside air position (and 100% exhaust air position when so equipped). Balance modulating dampers at extreme conditions, and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, minimum flow rate, and full heating; record all data.

K. Measure static pressure ahead of filters and heating coil. Measure static pressure at fan inlets and fan outlets. Correct any problems. Measure fan speed and motor inputs and compare with manufacturer's fan data to determine the point of operation. Adjust fan speeds to produce the correct air volumes. (Do not overload the motors.) Reread and record the pressure (positive and negative), RPM, and motor input readings.

L. Final air volumes shall be within 10% of design values except that specified room air pressure relationships must be provided. Provide reports on pressure relationships.

3.04 GENERAL REQUIREMENTS

A. Contact the temperature control contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.

B. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.

C. Division 15 Contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the project representative of these items and instructions will be issued to the Division 15 Contractor for correction of the deficient work.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1–GENERAL

1.01 SUMMARY

A. Work includes general requirements for all electrical work.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NFPA 70–National Electric Code.

B. ANSI/IEEE C2.

1.03 CONTRACT DOCUMENTS

A. Any device or fixture roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.

B. The Drawings are generally diagrammatic, and CONTRACTOR shall coordinate the work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.

1.04 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70.

B. Conform to ANSI/IEEE C2.

C. The rules and regulations of the federal, state, local, civil authorities, and utility companies in force at the time of execution of the Contract shall become a part of this specification.

D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be by CONTRACTOR.

1.05 CODES AND ORDINANCES

A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

B. In preparing Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the Drawings and specifications. All cases of serious conflict or omission between the Drawings, specifications, and codes shall be brought to ENGINEER's attention as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.

1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

A. Provide a complete electrical distribution system consisting of components indicated on the Drawings or specified herein, including but not limited to:
   1. 12.47 KV primary service entrance conduit raceways for power company conductors.
   2. All miscellaneous equipment coordination and related appurtenances required by power company.
   3. 4,160 volt, 3 phase, 4 wire service entrance conductors.
   4. Feeders, branch wiring, and electrical distribution equipment.
   5. All control wiring.
   6. Access panels and access doors for access to equipment installed by Division 16.
   7. Wiring between system components if equipment is not prewired.
   8. Lighting fixtures, lighting controls, and associated wiring.
   9. Telephone raceway system.
   10. Support system design and supports for electrical raceways.
   11. Code-required disconnects.

B. Provide a standby power system consisting of components indicated on the Drawings. (See Section 16230–Standby Power System.)

C. CONTRACTOR shall connect the following equipment furnished by Divisions 11, and 15 consisting of components indicated on the Drawings or specified herein, including, but not limited to:
   1. Unit heater fans.
   2. HVAC unit starters.
   3. Pumps, starters and control panels.
   4. Air intake and exhaust fans.
   5. Overhead door motors.
   6. Motorized actuated valves.

D. Provide balancing and adjusting of electrical loads.

E. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.

F. Provide miscellaneous items for a complete and functioning system as indicated on the Drawings and specified herein.

G. A partial list of work not included in Division 16 is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

A. Eliminate any abnormal noises which are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 DRAWINGS

A. The Drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.

B. Prior to locating light fixtures, confer with ENGINEER as to desired location in the various areas. In no case should fixture locations be determined by scaling drawings. Relocate fixtures and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.

C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on Drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.

D. The Drawings are schematic in nature and are not intended to show exact locations of conduit but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

A. The Drawings show approximate location of existing underground electrical based on OWNER-provided record drawings. CONTRACTOR shall excavate and verify the location of all underground electrical prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground electrical to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

B. Record drawings of existing underground electrical utilities are not available for this facility. CONTRACTOR shall excavate and verify the location of all underground electrical prior to installing new electrical equipment. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground electrical to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01300–Submittals for requirements.

B. CONTRACTOR shall, in addition, submit Drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:
   1. Electrical interconnection wiring diagrams; see Section 16480–Motor Control and Section 16940–Controls and Instrumentation.
   2. Major feeder routing in plan and elevation, including service entrance raceways and cable.
   3. Equipment room layouts showing exact locations and arrangements of equipment, feeders, wiring, etc., and clearances.

C. These Drawings and diagrams shall show all electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.

D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
   1. Proper sizes and capacities.
   2. That the item will fit in the available space in the manner that will allow proper service. Provide 1/4-inch scale plan view and elevations of all electrical rooms showing equipment layouts and clearances.
   3. Construction materials and finishes.

E. When the manufacturer's reference numbers are different from those specified, provide correct cross reference number for each item. The shop drawings shall be clearly marked and noted accordingly.

F. When fixtures, equipment, and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.

G. See additional requirements of shop drawings under Division 1–General Requirements.

PART 2–PRODUCTS

2.01 STANDARD PRODUCTS

A. All equipment shall be UL and NEMA approved.

B. Major distribution equipment such as panelboards, switchboards, switchgear, motor control centers, motor starters, TVSS units, transformers, etc., shall be by the same manufacturer.

C. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, rain-tight, explosion-proof, dust-tight, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment, sufficient data to show conclusively that it is equivalent to that specified in the following respects:

1. Performance:
   a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
   b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
   c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
2. Materials of construction.
3. Gauges, weights, and sizes of all portions and component parts.
4. Design arrangements, methods of construction, and workmanship.
5. Coatings, finishes, and durability of wearing parts.
6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.

B. Requests for substitution shall include CONTRACTOR's reason for the request.

C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.

D. See General Conditions for additional requirements.

PART 3–EXECUTION

3.01 UTILITY SERVICES

A. Utility connection requirements shall be determined. All costs for coordinating utility service shall be included in the price bid as described in Section 16420–Electrical Service System of these specifications.

B. All costs for temporary service, temporary routing of piping, or any other requirements of a temporary nature associated with the utility service shall be included.

C. It is the intent that in the latter stages of construction, the permanent electrical service will be used and the temporary construction service discontinued. The following requirements shall govern the use of the permanent services:

1. No permanent service shall be available until building is enclosed, watertight, and heated.
2. Only permanently connected and protected circuits and outlets shall be available.
3. Temporary wiring shall not be connected to permanent distribution equipment.
4. Under the above conditions, the use of permanent service equipment shall in no way affect the Contract conditions of the guarantee.

D. It shall be CONTRACTOR's responsibility to police this situation and protect their equipment.

3.02 CONTINUITY OF SERVICE

A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.

B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.

C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

3.03 CLEANING UP AND REMOVAL OF RUBBISH

A. All lighting and appliance panelboards, switchboards, MCCs, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cutoff prior to installation of covers.

B. Where louvers are provided in switchgear, MCCs, or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.

C. All lighting fixture lenses and lamps (interior and exterior fixtures) shall be cleaned at time of installation, and all lens exteriors shall be cleaned just prior to final inspection.

D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.04 CONCRETE WORK

A. All cast-in-place concrete for new electrical equipment bases shown on the Drawings shall be provided by CONTRACTOR except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including MCCs, free-standing enclosures, switchgear, etc. Pads shall be 3 inches larger than equipment being supported.

B. Concrete shall comply with Section 03300–Cast-In-Place Concrete.

C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.05 PAINTING

A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.

B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.

C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR to the satisfaction of ENGINEER.

D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.06 CAULKING

A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.

B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.

C. Caulking sealant shall contain no acid or ingredients which will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

D. Caulking shall be performed by craftsman skilled at such work.

3.07 BUILDING ACCESS

A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

3.08 COORDINATION

A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.

B. All starters, disconnects, relays, wire, conduit, push-buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the Drawings.

C. Where starters or other devices are provided by others, they shall be connected and wired by CONTRACTOR.

D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size,

horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.

E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters as specified here or under the various trades' sections of these specifications.

F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above) including temperature control wiring for operation, control, and supervision of all motorized equipment including wiring between motor starters and control devices all herein specified and as shown on the Drawings. Low voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment which has low voltage wiring unless otherwise noted. CONTRACTOR shall provide raceways for ALL low voltage wiring.

G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.

H. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volt, single phase, 60 Hz, unless otherwise shown.

3.09 EXCAVATION AND BACKFILL

A. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 02222–Excavation, Fill, Backfill, and Grading.

B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.

C. Care shall be taken to insure no disturbance of bearing soil under foundations.

D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 2 for rock excavation requirements.

3.10 EQUIPMENT ACCESS AND LOCATION

A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems which are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.

B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials which will fit properly the types of finishes actually installed.

C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.

D. Equipment shall be installed with ample space allowed for removal, repair, or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment which is to be installed or which is already in place.

E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

3.11 WORKMANSHIP

A. Install work using procedures defined in NECA Standard of Installation.

B. Location of process equipment as shown on the Drawings is approximate.

C. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.

D. Locations of utilization equipment and control devices as shown on Drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance will be performed at no additional cost to OWNER.

E. Unless otherwise noted, equipment shall be fastened to building structure or equipment framework and not placed on the floor.

F. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid.

G. Materials and equipment of the types for which there are National Board of Fire Underwriters' Laboratories (UL) listing and label service shall be so labeled and shall be used by CONTRACTOR.

3.12 AREA CLASSIFICATION

A. As noted on the Drawings.

END OF SECTION

SECTION 16120

WIRE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wire.
   2. Terminal blocks and accessories.
   3. Wiring connections and terminations.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Section 01300–Submittals.

B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.

C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Provide factory-wrapped, waterproof, flexible barrier material for covering wire on wood reels, where applicable; and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

PART 2–PRODUCTS

2.01 WIRE

A. All wire for permanent installation shall be new stranded copper, delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted.

B. Motor circuit branch wiring and associated control wiring:
   1. Insulation type shall be THHN.
   2. Minimum size for motor control wiring shall be 14 AWG.
   3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on Drawings.

C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2.

D. All wiring within control panels and supervisory control centers shall be insulation type THHN, minimum size 16 AWG.

E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be type XHHW-2. Damp and wet locations shall include but not be limited to exterior locations, buried conduits, wet wells, and any washdown areas.

F. All available colors shall be used; however, green shall be used only for equipment grounds. Where color-coded wire in larger sizes is not available, one wrap of 1-inch-wide, colored, self-adhesive tape at each terminal end shall be used for identification. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.

G. Color Coding:

	120/208/240V	277/480V
A Phase	Black	Brown
B Phase	Red	Orange
C Phase	Blue	Yellow
Neutral	White	Gray
Travelers	Yellow	Orange
Equipment Ground	Green	Green

H. Branch circuit wiring in excess of 75 feet, for ALL exit lights, emergency lights, and exterior lights shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

2.02 WIRING CONNECTIONS AND TERMINATIONS

A. Stranded conductors may only be terminated with UL or ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back-wired method.

B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal.

C. Provide in-line splices for all conductor connections, 6 AWG and larger. Splice crimp component shall be Burndy compression splice long barrel-bell entry, type YS-FXB, or equal. Splice insulation component shall be Raychem heavy-wall, low voltage tubing, type WCSM, or equal. No splices will be allowed unless approved by ENGINEER.

2.03 TERMINAL BLOCKS AND ACCESSORIES

A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed.

B. Power Terminals: Unit construction-type, closed-back-type, with tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction-type, channel mounted; tubular pressure screw connectors, rated 300 volts.

D. Manufacturer and Model Number: Phoenix Contact UK 5 N, or equal.

PART 3–EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which the work is to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 GENERAL WIRING METHODS

A. Install electrical wire and connectors in accordance with the manufacturer's written instructions; applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation"; and in accordance with recognized industry practices to ensure that products serve the intended functions.

B. Place an equal number of conductors for each phase of a circuit in same raceway.

C. Splice only in junction or outlet boxes. Avoid splices between terminals of interconnecting power and control wiring.

D. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, MCCs, and panelboards.

E. Make conductor lengths for parallel circuits equal.

F. The same color shall be used for each numbered wire throughout its entire length.

G. Terminate all wiring on terminal blocks in control panels, starter cubicles, and similar equipment.

H. Provide preprinted adhesive or heat shrink-type wire numbering labels at all terminations and splices. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (e.g. Brady labels) are not acceptable.

I. Use appropriate wiring methods and materials for the equipment or environment.

J. Do not use a pulling means which can damage the raceway.

K. Signal wiring (below 100 volts) must be in a conduit separate from power and/or control wiring (over 100 volts).

L. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.

M. Provide junction or pull boxes to facilitate the "pulling in" of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.

N. Thoroughly clean wires before installing lugs and connectors.

O. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.

P. Terminate spare conductors with electrical tape, label as "SPARE," and indicate where the conductors terminate.

3.03 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Yellow 77 pulling lubricant is not allowed.

B. Install wire in raceway after interior of building is enclosed, watertight, dry, and all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

D. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.

E. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation, or provide larger boxes approved for additional capacity.

F. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.

G. Circuiting is indicated diagrammatically on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Inspect wire for physical damage and proper connection.

B. Torque test conductor connections and terminations to manufacturer's recommended values.

C. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.

D. Subsequent to wire hook-ups, energize circuitry and demonstrate functioning in accordance with these specifications.

E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

F. Perform field inspection and testing according to provisions of this section.

3.05 ACCEPTANCE TESTS

A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.

B. CONTRACTOR shall be responsible for powered tests of each field installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.

C. Operation Test–By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the Drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.

D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and Drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.

E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.

F. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
   1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
   2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

3.06 WIRE INSTALLATION SCHEDULE

A. Install all wiring in raceways except as otherwise noted. This includes all low voltage wiring such as temperature control, phone, network, fiber optic, etc.

END OF SECTION

SECTION 16121

MEDIUM VOLTAGE CABLE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Medium voltage cable and medium voltage cable installation.
   2. Medium voltage cable terminations and devices for termination of medium voltage cables including provision for electrical stress relief and cable sealing.
   3. Medium voltage cable splices.
   4. Splicing and terminating equipment for cabling above 600 volts.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. The manufacturer shall be a company specializing in the manufacture of medium voltage cable and/or accessories with minimum five years documented experience in producing cable and/or accessories similar to those specified below.

B. The cable materials and manufacture shall meet or exceed all applicable requirements of the latest editions of ICEA Standard S-68-516, AEIC and NEMA standards.

C. The cable shall be manufactured using the triple tandem extrusion process in which all layers, from the conductor to, and including, the tape shield jacket, are installed at essentially the same time without an intervening storage period on reels or other storage devices.

D. CONTRACTOR shall be a company specializing in installation of medium voltage cable and accessories with a minimum of five years documented experience in installation of the type of cable and accessories described below.

E. Splicing and termination equipment for cabling above 600 volts shall be UL labeled.

1.03 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Section 01300–Submittals.

B. Submit manufacturer's certificate stating the factory test voltage (at least 45 kV DC for 5 kV rated cable and 80kV DC for 15 kV rated cable).

C. Submit manufacturer's certificate stating approval for field acceptance testing per National Electrical Testing Association standards (at least 36 kV DC for 5 kV rated cable and 64 kV DC for 15 kV rated cable).

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped, waterproof, flexible barrier material for covering cable on wood reels, where applicable; and weather resistant fiberboard containers for factory-packaging of cable, connectors, etc., to protect against physical damage in transit. Do not install damaged cable, or other material; remove from project site.

B. Store cable and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

PART 2–PRODUCTS

2.01 GENERAL

A. All cable shall be new, delivered to the site, and be less than two years since manufacture from manufacturer's stock; not suppliers' warehouse stock. Manufacturer's certification of factory test values shall be submitted for all cable furnished. All specified dimensions are nominal.

B. Provide a 600 volt insulated copper ground conductor in all conduits with medium voltage cable. See Section 16450 for additional grounding requirements.

2.02 CABLE (601 VOLTS AND ABOVE)

A. This specification describes single conductor XLP (thermosetting cross-linked polyethylene) insulated, shielded power cables for use in grounded neutral circuits not exceeding 15,000 volts phase to phase at conductor temperatures of 90°C for continuous normal operation, 130°C for emergency overload conditions and 250°C for short-circuit conditions. Cables are intended for general purpose applications in wet or dry locations. Provide 133%, 115 mils nominal insulation thickness for 5kV cables and 133%, 220 mils nominal insulation thickness for 15kV cables.

B. The following standard shall be a part of this specification: ICEA Publication No. S-93-639 for "Cross-linked–Thermosetting–Polyethylene–Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy", Class B stranded annealed coated or uncoated copper, per Part 2 of ICEA.

C. Conductors shall be covered with a layer of extruded conducting cross-linked polyethylene compound with a minimum thickness of 15 mils. The extruded layer shall be firmly bonded to the cable insulation and shall meet the resistivity requirements of Section 3 of ICEA. Directly over the conductor shielding shall be applied a homogeneous wall of XLP insulation. The average thickness of insulation shall be 115 mils for 5kV cables and 220 mils for 15kV cables. Minimum thickness at any point shall not be less than 90% of the specified thickness. Physical and electrical properties of the insulation shall be in accordance with Section 4.3.1 of ICEA and UL 1072.

D. Over the insulation shall be applied an extruded layer of conducting polyethylene shield. It shall be in intimate contact with the outer surface of the insulation and shall be free-stripping, leaving no conducting particles or other residue on the insulation surface. This layer shall be legibly identified as being conducting. The average thickness of this layer shall be not less than 30 mils and the minimum thickness at any point shall not be less than 90% of the average thickness. The polyshield layer shall meet the resistivity requirements of paragraph 4.1.1 of ICEA. Directly over the polyshield layer there shall be a helically applied 4mil copper shielding tape with a minimum 10% overlap. The tape shall meet the requirements of ICEA paragraph 4.1.1.1. A polyvinylchloride jacket shall be applied overall. This jacket shall meet the requirements of Section 7 of ICEA. The average thickness of the jacket shall be as specified in UL 1072. The minimum thickness at any point shall not be less than 80% of that specified.

E. All cable shall have surface identification showing manufacturer's name, insulation type, conductor size and voltage rating.

F. Cable shall be tested in accordance with ICEA S-93-639 and UL Standard 1072. Certified Test Reports shall be furnished prior to production of the cable.

G. Cable shall be shipped to permit testing on the reels prior to installation.

H. Cables with EPR insulation, CPE jacketing, or Unishield type shielding may be quoted from acceptable manufacturers.

I. Aluminum substitution is not acceptable.

2.03 JUMPER CABLE

A. Usage: This cable may only be used between equipment in the same vicinity such as between the primary switch and the transformer where adequate through-air clearance can be achieved between the conductors. It is not designed for and shall not be used in metallic raceways.

B. Cable: Single conductor, flexible, unshielded, insulated cable rated 15 KV, ungrounded. Sizes as indicated on the Drawings.

C. Conductor: Soft annealed copper, uncoated, concentric stranded, having nominal direct-current resistance equal to or less than that required in section 2.5.2 and Table 2-12 of ICEA S-68-516.

D. Conductor shield: extruded semiconductor with resistivity requirements of section 2.4 of ICEA S-68-516. Material shall be clean stripping from the conductor and firmly bonded to the overlying insulation.

E. Insulation: Extruded EPR (ethylene propylene rubber), rated at 15 KV, minimum thickness of .175 inches

F. Cable Rating: Continuous duty at 90 degrees C., dry locations.

2.04 CABLE TERMINATIONS

A. Indoor:
   1. Description: Stress cone consisting of a preformed elastomer contained in an insulating housing and compressed to form a void-free unit.
   2. Acceptable Manufacturers:
      a. Joslyn PS Catalog No. J 9275 (purchase cable terminations for the specific high voltage cable being supplied), Raychem HVT, or equal.
      b. Substitutions in accordance with the General Conditions.

B. Outdoor:
   1. Description: Preformed elastomer stress cone contained within a skirted porcelain housing and compressed to form a void-free unit.
   2. Acceptable Manufacturers:
      a. Joslyn PSC Catalog No. J 9280 (purchase cable terminations for the specific high voltage cable being supplied), Raychem HVT, or equal.
      b. Substitutions in accordance with the General Conditions.

2.05 MEDIUM VOLTAGE CABLE SPLICES

A. Description: Preformed elastomer splice manufactured for use with the cables involved. Built-up tape splices and poured insulating compound splices shall not be used.

B. Acceptable Manufacturers:
   1. Elastimold 2505 or 6505 (purchase cable terminations for the specific high voltage cable being supplied), Raychem HVS, or equal.
   2. Substitutions in accordance with the General Conditions.

2.06 CABLE LABELING

A. Cable labels shall be engraved, laminated plastic plates suitable for use from -40°F. to 150°F., and shall be resistant to oil, water and solvents. Nameplate shall be minimum size 1 1/2-inch by 4-inch. Face shall be white and the letters shall be black. Fasten label to cable with nylon tie-wraps. See paragraphs below for information type and label locations.

PART 3–EXECUTION

3.01 CABLE PULLING

A. Pump all water out of the manholes prior to beginning work.

B. Prior to pulling cable, a mandrel/swab 1/4 inch smaller than the duct diameter shall be pulled through duct run to insure adequate opening of duct run. Thoroughly swab conduits to remove foreign material before pulling cables.

C. Cables shall not be pulled from an outdoor (exterior) location when the outdoor (exterior) air temperature is below 40°F.

D. Cable pulling shall be done in accordance with cable manufacturer's recommendations, except as modified herein, and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions shall not be exceeded. Pulling bending radius shall not be less than that determined by the manufacturer or the NEC. Restrictions of pulling bending radius dimensions shall be strictly observed. Training bending radius shall not be less than 12 times cable diameter. Any cable bent or kinked to radius less than recommended dimension shall be replaced with new cable.

E. Actual pulling tensions shall be continuously monitored and permanently recorded in a log and submitted to ENGINEER at the completion of cable pulling. Pulling lubricant shall be used to ease pulling tensions. Lubricant shall be of a type which is noninjurious to the cable material used. Lubricant shall not harden or become adhesive with age.

F. Where cables are left in manhole or switchgear overnight or more than 8 hours prior to termination, the cable ends shall be sealed with paraffin or shrink wrap caps and supported in a manner which will prevent entrance of moisture into the cable. Cable shall be terminated and energized as soon as possible.

3.02 CABLE ROUTING IN MANHOLES AND SWITCHGEAR

A. Manholes as indicated on the Drawings shall have the cable looped around the walls, which shall circle the manhole at least 540°. Where manholes are not to be looped, cable shall be routed on the walls with the longest distance between points of entry and exit. Cables shall be arranged to avoid interference with duct entrances into manhole.

B. All new and existing cable in manholes shall be secured to racks on manhole walls. Cables shall be secured to racks with split porcelain insulators and clamps or mounted on a heavy duty nonmetallic cable rack system as manufactured by Underground Devices, Inc. Insulators shall be of adequate size to contain all three phases and the ground of a given circuit. Fastening cables directly to support channel with wire or plastic is not acceptable.

C. Cables within switchgear shall be routed in a manner that will allow adequate room for bending and terminating cables. Cables must be secured in a manner which will not result in cable weight being placed on the termination electrical joint. Cable support shall be made in a manner that does not force cable against grounded metal or which compresses cable diameter. Cable bending radius shall be at least 12 times cable diameter. Any cable bent to a radius less than recommended dimension will not be accepted.

D. Jumper cable shall be routed in a manner that prevents it from contacting any adjacent cable phase or any metallic surface.

3.03 SPLICES AND TERMINATIONS INSTALLATION

A. Splice locations are to be listed by the Contractor prior to cable purchase and a listing of such locations submitted to the Engineer for approval before final cable lengths are determined. Splice locations shall be determined by cable lengths available, pulling conditions and termination points. Follow cable manufacturer's and splice or termination manufacturer's installation instructions and ANSI/IEEE C2 standards.

B. Clean, white lint-free gloves shall be used to handle end of cable during tape wrapping procedures.

C. Termination or splicing of the copper conductors (both power and ground conductors) shall be made only with tool applied compression (swaged) fittings.

D. Ground system connections for cable to bus shall be compression cable fitting bolted to bus with lock washers under nut. Ground system connections for cable to ground rod shall be approved bolted fitting with backing plate between cable and rod. Ground cable shield at each termination and splice.

E. Splice or termination failure upon high potential acceptance test will require complete reconstruction of the joint to manufacturer's specifications. Provide enough free cable at each termination or splice for two more terminations or splices to be performed.

F. Scotch #70 tape shall be installed for anti-tracking on all exposed terminations.

G. All splices and terminations shall be tagged using embossed plastic tags with plastic attachment devices indicating date splice or termination was made, name of contractor installing cable, feeder number and circuit to and from data.

H. All cable splices in manholes shall be supported on both sides of the splice within 2 feet 0-inch of the splice. Splices shall not rely on cable for support.

I. Lugs shall be bolted to termination pads in equipment using corrosion resistant bolts, nuts, and washers. Provide lock washers for bolting copper to copper or as recommended by equipment manufacturer. Washers shall be on the lug side. Torque to manufacturer's recommendations.

3.04 FIREPROOFING OF MEDIUM VOLTAGE CABLES

A. Exposed cables in manholes, vaults, and cable trays shall be fireproofed as specified below. Additionally, cables shall be fireproofed in pull boxes, troughs, switchgear pull sections, bases, and pulling pits containing two or more sets of cable. Entire installation shall conform to manufacturer's recommendations.

B. Arc proofing material shall be Scotch #77 electrical arc and fireproofing tape, or approved equal.

C. Fireproofing shall be provided on cables noted above, as follows:
   1. Provide tightly applied fireproofing tape, approximately 1/16-inch-thick by 1-1/2 inches wide minimum, around each feeder spirally in one half-lapped wrapping.
   2. Provide tape with coated side towards cable and extend not less than one inch into each duct.
   3. Provide random wrappings of Scotch #69 glass cloth tape around installed fire proofing tape per manufacturer's instructions to prevent unraveling.

D. Wherever cables must pass through fire or smoke rated walls or floors, provide approved, sleeved, foam filled fire stops around cables as manufactured by O.Z., Dow, Square D, or equal.

3.05 CABLE ACCEPTANCE TESTS

A. Acceptance tests shall be performed as specified in Section 16950–Testing. CONTRACTOR shall coordinate the scheduling of the tests and provide labor and services

necessary to allow the test for each completed cable circuit. This shall include opening and closing equipment, providing temporary lighting and power as needed, etc.

B. Acceptance tests shall be performed on all cable after installation and prior to energization. All splices and terminations shall be completed and tested as part of the acceptance test.

C. In the event that test results are not satisfactory, CONTRACTOR shall make repairs and replace components as necessary to correct faults. Following corrections, tests shall be repeated to the extent required to prove the deficiencies are corrected.

3.06 CABLE IDENTIFICATION AND LABELING

A. Provide the following information on cable identification label:
   1. Feeder description.
   2. Volts/Amps.
   3. Origination and termination points.

   EXAMPLE:

FEEDER:	Pump No. 1
VOLTS/AMPS:	5 kV/200A
TO:	Pump No. 1
FROM:	Variable Frequency Controller

B. Install cable labels on each conductor at each cable termination, each cable splice, in each manhole and in each pullbox. Additionally, at these locations, provide 1-inch colored vinyl plastic electrical tape wrap identification, (Scotch 35, or equal) around each conductor and cable as follows:
   1. 5 KV individual conductor system:
      a. A-phase: One yellow wrap.
      b. B-phase: Two yellow wraps with 1/2-inch space between wraps.
      c. C-phase: Three yellow wraps with 1/2-inch space between wraps.
   2. 5 KV multiconductor cable system: three yellow wraps with no space between wraps.
   3. 15 KV individual conductor system:
      a. A-phase: One red wrap.
      b. B-phase: Two red wraps with 1/2-inch space between wraps.
      c. C-phase: Three red wraps with 1/2-inch space between wraps
   4. 15 KV multiconductor cable system: Three red wraps with no space between wraps.

C. See paragraph above under Splices and Terminations Installation for splice label requirements. This is in addition to identification labels.

D. During entire cable installation, phasing of conductors shall be maintained and identified. Where final connections to equipment are made, phasing shall be verified and proper phase rotation determined prior to connection.

E. All exposed conduits for conductors operating above 600 volts shall be painted red throughout length and at 50-foot 0-inch intervals shall be stenciled in white 2-inch by 1/4-inch letters: HIGH VOLTAGE 4,160 VOLTS.

F. All junction boxes and pull boxes for conductors operating above 600 volts shall be painted red and stenciled with 4-inch by 2-inch white letters: HIGH VOLTAGE 4,160 VOLTS.

END OF SECTION

SECTION 16130

BOXES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wall and ceiling outlet boxes.
   2. Pull and junction boxes.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NEMA OS 1–Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

B. ANSI/NEMA OS 2–Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. NEMA 250–Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 QUALITY ASSURANCE

A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel, 4-inch square or octagon, minimum 2 1/8 inches deep. Raco, Appleton, or equal.

B. Masonry and Partition Boxes: Galvanized steel, non-gangable. Thomas & Betts, GW Series, or equal. Provide number of gangs for devices shown on the Drawings.

C. Cast Boxes: Aluminum or cast faralloy, deep-type, gasketed cover, threaded hubs, Crouse-Hinds FD Series, or equal.

D. NEMA 4X Boxes: PVC or FRP, Carlon FS Series, or equal with proper cover and gasket.

2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1: Code gauge steel with galvanized or sheradized finish, secured by galvanized machine screws. Hoffman ASG Series without knockouts, or equal.

B. Cast Boxes: NEMA 250; Type 4, flat-flanged, surface-mounted junction box, UL-listed as watertight. Cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws, Crouse-Hinds WCB Series, or equal.

C. NEMA 4X Boxes: PVC or FRP, Carlon NS Series, or equal with proper cover and gasket.

D. Boxes Larger Than 12 Inches in Any Dimension: Hinged enclosure in accordance with Section 16160–Cabinets and Enclosures.

E. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

PART 3–EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.

B. Electrical box locations shown on Drawings are approximate. Verify location and size of floor boxes and outlets in all work areas prior to rough-in.

C. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.

D. Locate and install to maintain headroom and to present a neat appearance.

E. All boxes attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, all basement areas, tunnel areas, exterior

locations, garage areas, all wet wells and drywells, all areas below grade, and any washdown areas.

3.02 OUTLET BOX INSTALLATION

A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.

B. Provide knockout closures for unused openings.

C. Support boxes independently of conduit.

D. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

E. Install boxes in walls without damaging wall insulation.

F. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

G. Position outlets to locate luminaries as shown on electrical drawings.

H. In inaccessible ceiling areas, position outlet boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling opening.

I. Provide sheet metal recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall and adjustable steel channel fasteners for flush ceiling outlet boxes.

J. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

K. All concealed lighting outlet boxes shall be sheet metal octagon boxes.

L. In plaster or concrete walls, single receptacle, single- or double-switch outlets, use 4-inch square masonry boxes fitted with raised plaster covers. In poured concrete walls below grade, use cast boxes.

M. In unplastered brick or block walls use masonry boxes.

N. In metal door frames use partition boxes.

O. For weatherproof switches, devices, and exterior fixtures use cast boxes with proper cover and gasket.

P. All exterior outlet boxes shall be NEMA 4X.

Q. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.

R. Knock-out punches or saws shall be used for holes; boxes with pre-punched holes are not acceptable, except when used in conjunction with EMT conduit in areas where allowed.

S. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so they will support the weight of the fixture. Conduit will not be considered as adequate supports.

T. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.

3.03 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable except when used in conjunction with EMT conduit in areas where allowed.

D. All junction boxes shall be labeled with permanent labels (not adhesive type). Permanent labels shall include painted stencil-type labels or engraved laminated nameplates. In areas where conduit is painted, labels may be provided on the inside of the cover.

E. All interior exposed junction and pull boxes shall be cast-type with cover, unless noted otherwise.

F. All exterior junction and pull boxes shall be NEMA 4X. Boxes in areas subject to damage shall be stainless steel.

G. In inaccessible ceiling areas, position boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling opening.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Wall switches.
   2. Receptacles.
   3. Wall plates.
   4. Control switches.
   5. Photo cells.
   6. Time clocks.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NEMA WD 1–General-Purpose Wiring Devices.

B. NEMA WD 5–Specific-Purpose Wiring Devices.

C. Drawings–Bill of Materials.

1.03 QUALITY ASSURANCE

A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide electrical cable, raceways, wire, connectors, outlets, switches, etc., which have been listed and labeled by Underwriters' Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2–PRODUCTS

2.01 WALL SWITCHES

A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Cooper 222*, Leviton 122*, Pass and Seymour PS20AC*, or equal.

B. Provide ivory colored handles.

C. Pilot Light-Type: Pilot strap in adjacent gang.

D. Locator-Type: Lighted handle.

*Complete catalog number for pole arrangement necessary.

2.02 RECEPTACLES

A. 20 ampere, 125 volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Cooper 5362, Leviton 5362, Pass and Seymour 5362-A. 208 volt receptacles shall be grounded-type, rated same as circuit indicated on the drawings. Provide ivory coloring.

B. Locking-Blade Receptacles: NEMA WD 5.

C. Outdoor Receptacle: Pass and Seymour 2094, brown receptacle with Leviton Catalog No. 5977 cover and mounted vertically on nonferrous box.

D. Specific-Use Receptacle Configuration: NEMA WD 1 or WD 5; type as indicated on drawings.

E. GFCI Receptacles: Pass and Seymour 2094, Cooper XGF20, duplex convenience receptacle with integral ground fault current interrupter. GFCI receptacles shall not be series wired.

2.03 WALL PLATES

A. Each and every flush outlet shall be provided with standard 302 series stainless steel plates, blank, receptacle, switch or cord as designated by outlet symbol. Surface outlets shall have plates to match Crouse-Hinds, Appleton, or equal cast boxes.

B. Thermoplastic ivory cover plates shall be used in all "finished" areas.

C. NEMA 4X switch covers shall be Carlon, Industrial Gray, toggle switch cover for Type FS boxes, or equal.

2.04 CONTROL SWITCHES

A. Heavy-duty, oil-tight operators in NEMA 4X enclosures unless otherwise noted. Control stations shall be Square D, Class 9001, Type SKY, Allen Bradley Bulletin 800T, or equal, with operators as shown on the Drawings. Lockouts where called for on the drawings shall be Square D Type K5, or equal.

B. Manual switches shall be NEMA 4 water-tight and dust-tight (unless otherwise noted) as manufactured by Square D, Class 2510, Type K, or equal.

C. All switches and control devices shall have permanent labels as specified herein.

2.05 PHOTOCELLS

A. Photocell controller shall be rated 2000 watts tungsten at 120, 240, or 277 volts. The photocell shall be cadmium sulfide, 1-inch-diameter, gasketed for maximum weatherproofing.

B. Photo-cell mounting shall include a weatherproof wall plate with neoprene gasket suitable for attachment to an approved outdoor junction box.

C. Photocell controller shall include a delay of up to two minutes to prevent false switching. On-activation shall occur at 1-5 footcandles; off-deactivation shall occur at 3-15 footcandles.

D. Operational temperature range shall be -40°F to 140°F (-40°C to 60°C). All photocells shall be UL listed and include a 5-year warranty.

E. Photocell shall be Intermatic, or equal, K4000 Series with weatherproof wall plate, light shield, and neoprene gasket. Install where shown on the Drawings.

2.06 TIME CLOCKS

A. Unit shall be multipurpose, 24-hour electronic time switch with SPST switching configuration. Controller shall be capable of programming through the use of two slide switches and four push-buttons.

B. Unit shall include a manual control selection to override automatic control.

C. Battery shall be included with the unit to provide time-keeping and automatic carry-over functions. Display shall be LED-type. Unit shall include din-rail mounting bracket for installation in the lighting control enclosure.

D. Time clock shall be Intermatic, or equal, ET100C Series. All time clocks shall be UL listed.

2.07 THERMOSTATS

A. Line voltage thermostats for single stage heating or single stage cooling shall be Honeywell T6051A. Line voltage thermostats for single stage heating or single stage cooling in NEMA 4X areas shall be Honeywell T631F.

B. Line voltage thermostats for single stage heating or single stage cooling in Class 1, Division 1 locations shall be Honeywell T6051B.

C. Line voltage thermostats for two stage heating, two stage cooling, or one heating and one cooling stage shall be Honeywell T6052.

D. Analog (low voltage) thermostats shall be provided to generate a 4-20 mA signal for interface with the SCADA system. Thermostats shall include temperature transmitter and temperature sensor. Transmitters shall be installed in single-gang box and be TCS/Basys model TX1507. Provide intrinsic safety barrier for thermostats located in Class 1, Division 1 locations. Sensors shall be as follows:
   1. Sensors for outdoor air temperature shall be TCS/Basys model TS1003.
   2. Sensors for indoor NEMA 1 locations shall be TCS/Basys model TS1000.
   3. Sensors for NEMA 4X locations shall be TCS/Basys model TS1007 with Honeywell T7047C1090 enclosure.

E. Thermostats shown on the drawings shall be single stage unless otherwise noted.

PART 3--EXECUTION

3.01 INSTALLATION

A. Install wall switches 48 inches above floor (top of junction box), "Off" position down, except as otherwise noted.

B. Install wall dimmers 48 inches above floor (top of junction box); derate ganged dimmers as instructed by manufacturer; do not use common neutral.

C. Install convenience receptacles 15 inches above floor (bottom of junction box), grounding pole on bottom except as otherwise noted.

D. Install specific-use receptacles at heights shown on Contract Drawings.

E. Convenience Receptacles: Specification grade self-grounding.

F. Install devices and wall plates flush and level.

G. All Class 1, Division 1 or 2 devices shall be Crouse-Hinds, Appleton, or equal.

H. Backwiring shall not be used in wet locations, boiler rooms, or outside.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hinged cover enclosures.
   2. Cabinets.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NEMA 250–Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NEMA ICS 1–Industrial Control and Systems.

C. ANSI/NEMA ICS 6–Enclosures for Industrial Control Equipment and Systems.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Show Drawings for Equipment Panels: Include wiring schematic diagram, connection diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1.

PART 2–PRODUCTS

2.01 HINGED COVER ENCLOSURES

A. Construction: NEMA 250, larger than 12 inches in any dimension. Acceptable manufacturers: Hoffman, B-Line, or equal.

B. Covers: Continuous hinge, applicable NEMA rating with hasp and staple for padlock.

C. Back Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.

D. All cabinets with double doors or that are free-standing shall have 3-point latch.

2.02 CABINETS

A. Construction: NEMA 250. Acceptable manufacturers: Hoffman, B-Line, or equal.

B. Cabinet Fronts: Steel, surface-type with screw cover front, concealed hinge and flush lock. Finish in white baked enamel.

2.03 FABRICATION

A. Shop assembled enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide conduit hubs on all enclosures.

C. Provide protective pockets inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

D. Provide gasketed surfaces for all enclosure and cabinet doors and covers.

2.04 ENCLOSURE RATING

A. Cabinets and enclosures shall be rated as listed below, unless noted otherwise on the drawings:
   1. Indoor: NEMA 12, steel.
   2. Outdoor, corrosive or wet location: NEMA 4X, stainless steel.

2.05 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
   1. Arc-flash boundary.
   2. Flash hazard category (0-4).
   3. Minimum arc rating (cal/cm^2).
   4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3--EXECUTION

3.01 INSTALLATION

A. Install cabinets and enclosures plumb. Anchor securely to wall and structural supports at each corner, minimum.

B. All cabinets and enclosures shall be labeled with permanent labels (not adhesive type). Permanent labels shall include painted, stencil-type labels or engraved laminated nameplates (4-inch by 4-inch minimum size).

C. Provide accessory feet for free-standing equipment enclosures.

D. Install trim plumb.

E. All cabinets and enclosures attached to building surfaces which may be damp shall be spaced out to avoid rust and/or corrosion. All boxes in damp locations shall be on 1-inch standoffs. Damp locations shall include, but not be limited to, all basement areas, tunnel areas, exterior locations, garage areas, all wet wells and drywells, all areas below grade, and any washdown areas.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Conduit and equipment supports.
   2. Fastening hardware.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2–PRODUCTS

2.01 MATERIAL

A. Support Members:
   1. 316 stainless steel, fiberglass, or PVC in exterior locations.
   2. Galvanized steel in all other areas.

B. Hardware:
   1. Stainless steel in exterior locations.
   2. Galvanized steel in all other areas.

PART 3–EXECUTION

3.01 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors. Do not use spring steel clips and clamps.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

D. Do not use powder-actuated anchors.

E. Do not drill structural steel members.

F. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring lock washers under all nuts.

G. In wet locations install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls and caulk.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

J. Do not use chain hangers.

K. All welds shall be continuous and ground smooth.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Nameplates.
   2. Wire and cable markers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Provide schedule for nameplates and labeling tags with shop drawings. Reference drawings for type used.

PART 2–PRODUCTS

2.01 MATERIALS

A. Type "A" Nameplates:
   1. Use:
      a. Motor starters.
      b. Each separately mounted circuit breaker or disconnect switch.
      c. Each device in main distribution panels.
      d. Each device in switchboards.
      e. Each device in Motor Control Centers.
      f. SCADA System computers.
   2. Size: 1 1/8-inch by 3 5/8-inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/4-inch.
   7. Engraving: See MCC schedule and one-line for labels or as requested by ENGINEER.
   8. Mounting Location: Front exterior.

B. Type "B" Nameplates:
   1. Use: Standby power systems as in "A" above.
   2. Size: 2-inch by 3 5/8-inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Red.
   5. Character Color: White.
   6. Character Size: 1/4-inch.
   7. Engraving: See MCC schedule and one-line for labels or as requested by ENGINEER.

8. Mounting Location: As requested by ENGINEER.

C. Type "C" Nameplates:
   1. Use:
      a. Motor Control Centers.
      b. Switchboards.
      c. Supervisory Control Centers.
      d. Switchgear.
      e. Panelboards.
      f. Transformers.
   2. Size: 4-inch by 4-inch.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 2 1/4-inch.
   7. Engraving: Equipment label, Emergency to be white with red letters.
   8. Mounting Location: Equipment: Top wireway.

D. Type "D" Nameplates:
   1. Use: Identify control stations, thermostats, etc.
   2. Size: 3/8-inch by 2-inch.
   3. Material: 3 Layer Laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/8-inch.
   7. Engraving: Control station number or equipment controlled.
   8. Mounting Location: Device front at top.

E. Type "E" Nameplates:
   1. Use: Identify function of process and HVAC control panels.
   2. Size: As necessary.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/8-inch.
   7. Engraving: Control Panel Function.
   8. Mounting Location: Panel Face as requested by ENGINEER.

F. Type "F" Nameplates:
   1. Use: Identify Supervisory Control Center communication and I/O modules.
   2. Size: As necessary.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 1/8-inch.
   7. Engraving: Operating function.
   8. Mounting Location: As requested by ENGINEER.

G. Type "G" Nameplates:
   1. Use: Description of control panel function.
   2. Size: As necessary.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Black.
   5. Character Color: White.
   6. Character Size: 3/16-inch.
   7. Engraving: Operating function.
   8. Mounting Location: As requested by ENGINEER.

H. Type "H" Nameplates:
   1. Use:
      a. Telephone Distribution System.
      b. Electrical Distribution System.
      c. Fire Alarm System.
      d. Intrusion Alarm System.
      e. Clock System.
      f. Sound System.
      g. Public Address System.
      h. Closed Circuit Television System.
   2. Size: As necessary.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Yellow.
   5. Character Color: Black.
   6. Character Size: 3/16-inch.
   7. Engraving and Mounting Location: As requested by ENGINEER.

I. Type "I" Nameplates:
   1. Use: Operator instructions.
   2. Size: As necessary.
   3. Material: 3-layer laminated Micarta.
   4. Background Color: Yellow.
   5. Character Color: Black.
   6. Character Size: 3/16-inch.
   7. Engraving and Mounting Location: As requested by ENGINEER.

J. Labeling Tags:
   1. Use: Field-mounted devices (valves, limit switches, etc.).
   2. Size: 1-inch by 3-inch.
   3. Material: 1/32-inch-thick stainless steel.
   4. Character Size: 1/4-inch.
   5. Engraving: As requested by ENGINEER.

K. Wire Markers:
   1. Wire markers shall be permanently attached wrap around adhesive, sleeve or heat shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wrap around numbers (such as Brady preprinted markers) are not acceptable.
   2. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

PART 3–EXECUTION

3.01 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Affix nameplates with stainless steel screws in outdoor locations and stickyback adhesive in indoor locations.

D. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8-inch hole to accommodate wire tie.

E. Prepare and install neatly typed directions in all panels including existing panels where work is done under this Contract.

3.02 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring.

B. Conductors in pull boxes, motor control centers, supervisory control panels, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

END OF SECTION

SECTION 16335

MEDIUM VOLTAGE MOTOR CONTROL

PART 1–GENERAL

1.01 REQUIREMENTS

A. This Specification covers motor controllers for control and protection of 4,000 volt, 3 phase, 60 hertz motors. Controllers shall be designed, manufactured, assembled and tested in accordance with NEMA and UL Standards.

B. The medium voltage motor controllers shall be furnished, installed, and connected in a Motor Control Center line-up with fused medium voltage switchgear.

C. Starter, variable frequency drive, controls and protective interlocks shall be coordinated with the pump and electric check valve manufacturer for correct operating features.

D. Refer to Section 16940 for additional control requirements.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Allen-Bradley, or equal.

2.02 EQUIPMENT

A. Motor Control Center Construction:
   1. Basic structure shall consist of a metal enclosed free-standing dead-front vertical steel assembly. All doors shall be minimum 14 gauge sheet metal, pan type with flanges formed to provide sturdy, rigid structure. Compartment door latches and hinges shall be capable of holding door closed during maximum fault condition. Ventilation openings shall be provided where required with protective barrier behind them.
   2. Enclosures shall be free standing, NEMA-1. All metal parts to be give a thorough rust resistant treatment, then painted with one coat of ANSI-49 medium grey baked enamel.
   3. Controllers in individual sections shall have three distinct, isolated compartments as follows:
      a. Line terminations, power bus, and isolating switch compartment shall be at top rear portion of each vertical section.
      b. Medium voltage compartment shall include mechanical and electrical interlocks to minimize electrical hazards. This compartment shall have hinged door to permit easy access to medium voltage equipment such as: fuses, current transformers, and contactor.
   4. Design shall provide complete front accessibility to all electrical parts when installed against walls or for back-to-back arrangements.
   5. Space heaters shall be provided in each enclosure to prevent condensation, wired for 240 volt single phase service from the building lighting panelboard.

B. Power and Ground Bus:
   1. Horizontal bus shall be located in the center at the back of the structure. Bus shall have minimum continuous current carrying capacity of 1200 amperes, and shall be supported on 5 KV fiberglass polyester insulators.
   2. Ground bus shall be continuous and extend from one end of motor control center to other through each vertical section. Bus shall be located in bottom of each vertical section. Ground bus shall be ¼" x 2".
   3. All bus bars shall be tin-plated copper.
   4. All bus bars and cables shall be braced to withstand, without damage or deformation, maximum let through current permitted by current limiting fuses. The horizontal bus fault withstand rating shall be 60KA RMS symmetrical for 10 cycles. The vertical bus fault withstand current rating shall be 50KA RMS symmetrical for one half cycle.
   5. All bolted bus joints shall have minimum of two holes. To facilitate future extension of motor control center on either side, horizontal bus and ground bus shall be provided with suitable bolt holes.
   6. The equipment shall be capable of withstanding horizontal and vertical accelerations (seismic design category C) without overturning.

C. Wiring:
   1. Controllers shall be complete with all internal power and control wires including terminations for external connections. Phase sequencing shall have proper identification and all wire shall have suitable markings at all terminations.
   2. Motor cables requiring stress cones shall be connected to current transformers or stand off insulators. Space shall be provided for terminating a maximum of 3-500 MCM cables per controller for top or bottom entry.
   3. Space shall be provided for stress cones for incoming line and load cabling on all types of construction.

D. Main Disconnect:
   1. Provide main overcurrent protection as indicated on the drawings.
   2. The withstand rating of the main shall be greater than or equal to the bus bracing for the controller.
   3. Provide lugs to accommodate the shielded conductors as indicated on the drawings.
   4. If no overcurrent protection is indicated, provide a main incoming lug compartment.
   5. Provide metal oxide station type surge arrestors.
   6. Main Fusible Disconnect:
      a. The main disconnect shall utilize a three-pole gang-operated load break switch with an external operating handle.
      b. A quantity of (3) current limiting power fuses shall provide the overcurrent protection.
      c. The operating handle shall be fully interlocked with the power cell door.
      d. Provisions shall be provided on the operating handle for key interlocking.
      e. The power cell door shall be provided with a viewing window to examine the switch position.
      f. Inside the power cell, provide a protective guard to isolate the medium voltage line terminals when the power cell door is open.

E. Feeder Disconnect:
   1. Provide feeder disconnects with overcurrent protection as indicated on the drawings.
   2. The disconnect shall be a fused load break switch.
   3. A quantity of (3) current limiting power fuses shall provide the overcurrent protection.
   4. Units shall be provided in two high construction for units rated 400 Amps and below.

5. The feeder disconnect unit shall consist of three isolated compartments:
   a. Power Bus Compartment
   b. Power Cell
   c. The functional compartment specifications shall follow the motor specification where applicable.
6. Provide (3) load cable terminals.

F. Reduced Voltage Autotransformer Controller:
   1. Provide the quantity of autotransformer starters as shown on the drawings.
   2. The structure shall be divided isolated compartments:
      a. Main power bus and ground bus compartment.
      b. Power cell compartment.
      c. Low voltage compartment.
      d. Low voltage wireway across the roof of the structure if specified.
   3. Power Cell Compartment:
      a. Main Isolating Switch:
         (1) The main power cell shall have an externally operated, 3-pole, gang operated, fixed mounted non-load-break isolating switch.
         (2) The isolating switch shall isolate the power bus compartment from the power cell by means of a positively driven shutter mechanism to prevent accidental contact with line terminals in the power bus compartment.
         (3) The main power cell door shall have a viewing window through which the operator can verify that the isolating switch position.
         (4) The isolating switch shall only have the ability to interrupt the no-load (magnetizing) current of the control power transformer(s) (CPT) and/or potential transformers (PT) supplied inside the controller power cell.
         (5) In the open position, the isolating switch and contactor shall provide a means of grounding appropriate medium voltage power cell components, bleeding off hazardous stored energy, thus providing safe operation and maintenance.
         (6) One or more N-O and N-C auxiliary contacts shall be arranged to open the secondary circuit of the CPT and/or PT, de-energizing the control circuit. This is to ensure there is no load on the isolating switch when it is opened or closed. The contacts shall also prevent backfeeding through the CPT and/or PT, and isolate the power cell when the control circuit is in the TEST mode. It shall only be possible to operate the TEST control circuit when the isolating switch is in the open position.
         (7) The isolating switch shall remain connected to the external operating handle at all times. The isolating switch shall also be mechanically and electrically interlocked with the main contactor.
         (8) The external isolating switch operating handle shall have provisions to be padlocked, with up to three (3) padlocks in the open position, and one (1) padlock in the closed position. The closed position shall be located and marked, but shall be drilled out by the USER to allow insertion of the padlock.
         (9) The power cell door on each controller shall be interlocked with the isolating switch such that any medium voltage door(s) cannot be opened when the isolating switch is fully closed, and the isolating switch cannot be closed with the door(s) open (without defeating the safety interlock).

b. Interlocking:
   (1) Provide mechanical interlocking (including cable interlocks, horizontal ram interlocks and vertical ram interlocks) to prevent the opening of any power cell door or medium voltage compartment until the non-load-break isolating switch is fully in the open position and power is removed (the external operating handle must be in the "OFF" position).
   (2) Optional key interlocks, configured to operate with the operating handle or power cell door, shall be available when interlocking is required with another specified device, i.e. main breaker, load-break switch, starter, etc.

c. Power Fuses and Fuse Holders:
   (1) The power cell shall be designed to accept bolt-on or clip-on current limiting power fuses.
   (2) The medium voltage product shall have fixed power fuse holders that are separately mounted in the power cell, not on the contactor, and are located to allow easy inspection and replacement without any disassembly or removal of other components.
   (3) The power fuses shall provide visual condition indication by way of a spring-actuated blown fuse indicator.
   (4) The power fuse size shall be selected based on load data provided by client. If the data is not provided, assumed data will be used to size protective devices.

d. Current Transformer:
   (1) The medium voltage power cell shall include three (3) current transformers of sufficient VA capacity to meet the requirements of all the devices connected to them.
   (2) Each current transformer shall have the primary rating sized appropriately in relation to the full load current rating of the motor or feeder. The secondary of the current transformers shall have a 5 amp output and accuracy suitable for the type and quantity of protection or metering devices connected to it. All current transformer control wiring shall be terminated on the current transformer with locking-type, fork tongue lugs.
   (3) An appropriate load termination location shall be provided to accommodate lugs with single or two-hole mounting, for connection of the load cables.
   (4) The power cell shall have provisions to locate a toroid (donut) style, ground fault sensing current transformer, when the zero sequence ground fault protection feature is required.

e. Control Power Transformer:
   (1) The control power shall be 120 V AC and shall be obtained from a control power transformer (CPT) located in each controller power cell.
   (2) The dry-type CPT shall be minimum 500 VA, sized based on actual load requirements.
   (3) The secondary circuit of the transformer(s) shall be disconnected from the control circuit by means of the isolating switch auxiliary contacts. This is to ensure the isolating switch does not make or break load current, to prevent backfeeding through the transformer(s) and to isolate the power cell when the control circuit is in the "TEST" mode.
   (4) The standard control power transformer used in the controller shall be a compensated type with output accuracy of approximately 4 percent over nomal at no load.
   (5) Appropriately sized primary and secondary fuses shall be supplied.

f. Vacuum Contactor Specifications:
   (1) The electrically (magnetically) held medium voltage contactor shall be the Allen-Bradley Bulletin 1503 vacuum type or equal.
   (2) The open current ratings shall be used 400 Amps.
   (3) The contactor shall have visual contact wear indicators. No special tools or gauges are required for checking contact wear.
   (4) Vacuum bottle and coil maintenance shall not require removal of the vacuum contactor.
   (5) The vacuum contactor shall be fixed mounted inside the power cell. The contactor shall be interlocked with the non-load-break isolating switch, both electrically and mechanically, to provide the following safety features:
      a. Prevent the isolating switch from being opened or closed when the contactor is in the closed position.
      b. Prevent the opening of the medium voltage door when the isolating switch is in the closed position.
      c. Prevent the closing of the isolating switch when the medium voltage door of the controller is open.
      d. Removal of control power from the control power transformer (CPT), potential transformers (PTs) or external power source to the control circuit when the isolation switch and contactor are in the open position.

4. Low Voltage Compartment:
   a. Each controller shall have a separate, front accessible, low voltage control compartment. The compartment shall be completely isolated, using metal barriers between the low voltage compartment and the power cell and/or main power bus compartments.
   b. The low voltage panel shall allow for front access without turning the controller OFF when opening the low voltage panel door.
   c. The panel shall be of a swing-out design to provide easier access to the power cell for bus splicing, to make load cable connections and to provide easier access to extra medium voltage components. The panel shall be interlocked with the power cell compartment to prevent the panel from swinging open until the power cell is OFF and isolated from the main power bus.
   d. Meters, protective relays, selector switches, operators, indicating lights, etc., shall be mounted on the front of the low voltage control panel, and arranged in a logical and symmetrical manner.
   e. Provide space for low voltage control devices, transducers and metering.
   f. Provide necessary quantity of terminal blocks.
   g. All remote low voltage cable shall be able to enter from the top or bottom of the structure. Access to the wireways shall be by means of removable entry plates on the top and bottom of the structure.
   h. Pilot control relays shall be used to operate and economize the vacuum contactor.
   i. The control panel supply voltage shall be 110/120 or 220/230 VAC. It shall be rectified to provide a DC operating voltage for the vacuum contactor coils and economizing relay.
   j. There shall be a 2-pole, 3-conductor (with a grounding prong) male plug to provide a means of connecting a 2-pole, 3-conductor receptacle from a remote 120 V AC, 60 Hz supply to operate the control circuit when it is in the TEST position.
5. The reduced voltage autotransfer controllers shall be a closed transition design and include three fixed mounted vacuum contactors (1S, 2S and Run).
6. Provide a three winding autotransfer:
   a. The transformer shall be rated for medium duty.
   b. The transformer shall be three winding.

c. The transformer shall have taps for 50, 65, and 80 percent. Unless indicated, factory wired using the 65 percent tap.

7. Motor Protection Options:
   a. For across the line and reduced voltage auto-transformer controllers, provide a solid state overload motor protective relay.
      (1) The motor protective relay shall be Allen-Bradley Bulletin 825P, or equal.
      (2) The relay shall provide the following protective features:
         a. Electronic motor overload
         b. Phase imbalance
         c. Jam
         d. Underload
         e. Ground (Earth) fault
         f. Starting time monitor
         g. Limited starts per hour
      (3) Standard RS 232 communication shall be available via the front of the relay to enable programming.
      (4) The relay shall be provided with a current converter module, to provide CT isolation, mounted on the low voltage panel.
8. Motor Run Time Meter:
   a. Provide a digital, non-resettable, door-mounted elapsed time meter.
   b. The meter shall have six digits with tenths.
9. Motor Heater Control:
   a. Provide control circuitry to interface with a remote 120 VAC / 2700 W power source to energize the motor heater whenever the motor is not running.
   b. The heater shall be interlocked with the motor run relay and shall be energized whenever the motor is not running.
   c. Provide a white pilot light mounted on the enclosure door for indication of Motor Heater On.
10. Low Voltage Surge Suppressors:
   a. Provide low voltage surge suppressors across each 120 V coil in the control circuit.

G. Medium Voltage Variable Frequency Drives:
1. Provide the quantity of variable frequency drives as shown on the drawings.
2. The VFD shall produce a variable voltage and a variable frequency output to provide continuous operation over the application speed range.
3. Variable frequency drives shall be sized to operate motors actually supplied for this project. CONTRACTOR shall be responsible to provide appropriately sized variable frequency drives.
4. The VFD shall provide stable operation of the motor without compromising the motor insulation system, regardless of motor cable distance. If an output filter is required to mitigate reflected waves, or to meet any special requirements of the application, it must be integral to the VFD controller.
5. The VFD shall comply with IEEE 519 Harmonic Guildines.
6. VFD minimum efficiency shall be 96% at 100% speed and 100% load.
7. VFD power factor shall be a minimum of 0.98.
8. The VFD shall have the following minimum protection features:
   a. Under voltage (adjustable)
   b. Over voltage (adjustable)
   c. Instantaneous over current (adjustable)
   d. Ground fault (adjustable)
   e. Overload (adjustable)

f. Gate driver power supply under voltage
g. Control power over/under voltage and signals
h. Over temperature protection
i. Short circuit protection (instantaneous over current)
j. Overload (delayed over current)
k. Over voltage (adjustable)
l. Motor over speed (adjustable)

9. VFD shall provide the following motor protection:
   a. Electronic motor overload protection shall be supplied as standard.
   b. If specified on the data sheet, an optional RTD relay for sensing actual motor temperature and drive shutdown shall be supplied.
   c. A motor stall protective function will be supplied on all units. The amount of time the drive will be allowed to run at current limit under minimum speed shall be adjustable.
   d. If specified on the data sheet, a multi-functional motor protection relay (MPR) shall be supplied when a bypass starter is requested.
   e. If specified on the data sheet, motor space heater control shall be provided.
10. VFD Operator Interface shall be a user-friendly terminal with the following minimum features:
   a. Large LCD display screens (minimum 16 line-40 characters) that are easy to read and provide "at a glance" indication of drive operating status.
   b. User configurable bar type LCD metering for motor speed, load, torque, and voltage.
   c. Elapsed time indication.
   d. Extensive diagnostic functions that provide separate fault and warning queues in non-volatile memory that retain information under all conditions.
   e. On-line help that provides enhanced fault text messages.
   f. Trend buffers for a least 8 variables that allow one-shot or multi-shot trending.
   g. Multi-level password access to ensure that only qualified personnel have access to critical parameters but still allow easy access to other levels of personnel.
   h. Extended use of plain language messages to eliminate need to look up error codes or decipher the meaning of error messages.
11. The VFD shall be air cooled. Air-cooled VFDs shall be provided with a mixed flow cooling fan, mounted integral to the VFD enclosure. The VFD shall include air-flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If a fan fails, the system must generate alarm indication of the fan failure. Vane type air-flow switches are not acceptable. If specified on the attached data sheet, provision shall be made for ducting VFD exhaust air outside the control room.
12. VFDs shall be provided in NEMA 1 enclosures, fabricated from minimum 12 gauge steel. The VFD shall be designed for front access to all equipment.
13. VFDs shall be provided with bypass controllers utilizing reduced voltage autotransfer start. The bypass starter shall be provided with an output vacuum contactor, isolating switch and mechanical and electrical interlocking.

H. Power Factor Correction Capacitors:
   1. Provide factor correction capacitors shall be located in each controller or atop the controller cabinet sized based on equipment manufacturer recommendations. Capacitors shall have discharge resistors and meet NEMA and ANSI standards.

I. Pilot Devices:
   1. Pilot devices shall be Allen-Bradley Bulletin 800H (NEMA Type 4/4X/13) and shall be mounted on the enclosure door.
   2. For motor starters, provide a "Hand/Off/Auto" selector switch for start-stop control and pilot lights for indication of the "Hand" and "Auto" modes.
   3. For motor starters, provide Start and Stop bushbuttons. For solid state reduced voltage starters also provide either a Pump Stop and Soft Stop bushbutton.
   4. For motor starter provide pilot lights, mounted on the enclosure door, for indication of ON, OFF and OVERLOAD. Pilot lights shall be transformer type.

J. Terminal Blocks:
   1. Provide ten additional unwired terminal blocks in each unit.
   2. Shall be Allen-Bradley type 1492, or equal.

K. Auxiliary Relays:
   1. Provide auxiliary control relays as indicated on the drawings.
   2. The relays shall be Allen-Bradley 700P or 700CF relays, or equal.

END OF SECTION

SECTION 16412

TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Service entrance devices.
   2. Branch panel devices.
   3. Local panel devices.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/IEEE C62.41 and C62.45.

B. NFPA 70, and 75.

C. UL 1449, most recent issue.

1.03 QUALITY ASSURANCE

A. Manufacturers of transient voltage surge suppressors. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide TVSS devices which have been listed and labeled by Underwriters' Laboratories.

E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports

certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

1.05 WARRANTIES

A. Manufacturer shall provide a 10-year warranty from the date of substantial completion to cover repair or replacement of the device. This warranty shall exclude plug-in modules and coordinated fuses, both of which shall carry a lifetime warranty.

PART 2--PRODUCTS

2.01 GENERAL

A. These specifications describe the electrical and mechanical requirements for shunt installed AC power line (local panels) surge suppressors and for high energy transient voltage (service entrance and branch panels) surge suppressors. The specified surge protective device shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-1991 location Category C3 (service entrance), location category B3 (branch panels), and location category Local Service Panel (local panels). Testing shall be per ANSI/IEEE C62.45–1992 using ANSI/IEEE C62.41 Category C3, B3, and Local Service Panel waveforms and amplitudes.

B. The system individual units shall be UL listed under UL1449 Standard for Transient Voltage Surge Suppression (TVSS) and the surge ratings shall be permanently affixed to the TVSS.

C. Operating Temperature: Operating temperature range shall be -40 to +55°C (-40 to 131°F).

D. Storage Temperature: Storage temperature range shall be -40 to +85°C.

E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.

F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.

G. Design Life: >15 years.

H. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% of the nominal rated line voltage.

I. Power Frequency: The power frequency range shall be at 47 to 440 Hertz.

J. All TVSS devices shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

2.02 SERVICE ENTRANCE DEVICES

A. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least: 1 Event at 160 kA. The

surge life (8/20) shall be at least 6kA for 10,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses.

B. The suppressor shall be capable of interrupting a 65 kA, short circuit current delivered from the AC power line. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.

C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.

D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple 40 mm metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with two replaceable fuses per module.

E. Red and green solidstate LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.

F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Normally open and normally closed contacts shall be provided with voltage and current limiting protection.

G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.

H. A front panel built-in surge counter shall be included to record the number of suppression events. A switch shall be provided for resetting the counter.

I. A 14 gauge, NEMA Type 4, steel enclosure, with corrosion-resistant hardware shall be provided for the unit.

J. Service entrance devices shall be as manufactured by MCG, SF160M Series, or equal.

2.03 BRANCH PANEL DEVICES

A. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least: 1 Event at 80 kA. The surge life (8/20us) shall be at least 3 kA for 10,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses.

B. The suppressor shall be capable of interrupting a 65 kA, short-circuit current delivered from the AC power line. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.

C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the installation notes for best performance.

D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple 40 mm metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector will provide redundant protection within each phase module with two replaceable fuses per module.

E. Red and green solidstate LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.

F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Normally open and normally closed contacts shall be provided with voltage and current limiting protection.

G. The specified system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.

H. A front panel built in surge counter shall be included to record the number of suppression events. A switch shall be provided for resetting the counter.

I. A 14-gauge enclosure, NEMA Type 4 steel, with corrosion-resistant hardware shall be provided.

J. Branch panel devices shall be as manufactured by MCG, SF120M Series, or equal.

2.04 LOCAL PANEL DEVICES

A. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least: 1 Event at 40 kA, the surge life (8/20 us) shall be at least 3 kA for 10,000 occurrences. The transient suppression capability shall be bidirectional and suppress both positive and negative impulses.

B. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the installation notes for best performance.

C. The suppressor shall be fused and constructed of multiple 20 mm metal oxide varistors.

D. An illuminated green solidstate LED indicator shall be provided on the front cover for each phase to indicate protection is present at the device on all phases.

E. Local panel devices shall be as manufactured by MCG, model SF40, or equal.

2.05 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
   1. Arc-flash boundary.
   2. Flash hazard category (0-4).
   3. Minimum arc rating (cal/cm^2).
   4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.

B. Each device shall be installed in parallel with the protected equipment. No series connected protective elements shall be used. Each installed device shall be fed by a 3-pole, 30-amp circuit breaker in the protected panel.

C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for service entrance and branch panel devices. Local panel devices shall be furnished with No. 12 AWG leads having a nominal length of 36 inches.

D. Manufacturer shall provide protection modules and coordinated fuses under a no-cost lifetime replacement warranty.

END OF SECTION

SECTION 16420

ELECTRICAL SERVICE SYSTEM

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
1. Utility company.
2. Primary service characteristics.
3. Secondary service characteristics.
4. Definitions.
5. Sequencing, scheduling.
6. Underground electrical service.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 UTILITY COMPANY

A. The Utility Company is Kentucky Utilities Company.

1.03 PRIMARY SERVICE CHARACTERISTICS

A. The primary service to the service transformer will be 12,470 volt, 3 wire, 3 phase.

1.04 SECONDARY SERVICE CHARACTERISTICS

A. The secondary service will be 4,160 volt, 3 wire, 3 phase.

1.05 DEFINITIONS

A. Service–As defined in the NEC, Article 100.

B. Primary Voltage–Above 600 volts.

C. Secondary Voltage–600 volts and below.

1.06 SEQUENCING, SCHEDULING

A. Provide electrical service system, except the Utility Company will provide:
1. Protective device at terminal pole.
2. Protective device at transformer.
3. Transformer (pad by CONTRACTOR).
4. Transclosure.
5. Metering at transformer.
6. Cable from terminal pole to transformer.
7. Secondary cable as shown.

1.07 UNDERGROUND ELECTRICAL SERVICE

A. Provide complete underground electrical service except for items furnished and installed by the Utility Company.

B. Duct Lines: PVC conduit, heavywall rigid, type 40 listed for underground encased applications.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 INSTALLATION

A. Trench and backfill for duct lines and manholes in accordance with Division 2–Site Work.

B. Provide concrete work in accordance with Section 03300–Cast-in-Place Concrete with minimum 3,000 psi concrete.

C. Provide 3-inch-thick pitched concrete support slab with cast-in-place No. 9 galvanized wire tie-down anchors spaced 48 inches o.c. for concrete ductlines.

D. Install top of duct lines a minimum of 2 feet below finish grade and pitched for drainage.

E. Install base and intermediate spacer at every coupling point of each duct lines for a 2-inch separation horizontally and vertically.

F. Anchor duct lines with cast-in tie-down anchors.

G. Encase duct lines in concrete, 3 inches minimum on sides, top, and bottom.

H. Notify ENGINEER 24 hours in advance of any duct line concrete pour.

END OF SECTION

SECTION 16440

DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Disconnect switches.
   2. Fractional HP motor switches.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS–DISCONNECT SWITCHES

A. Square D, Class 3110.

B. Cutler-Hammer, Type DH.

C. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1; heavy-duty; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position. Fuse Clips: Designed to accommodate Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position.

2.03 FRACTIONAL HP MOTOR SWITCHES

A. Fractional horsepower manual motor starter with thermal overload(s), sized for motor nameplate data. Single pole for 120 volt, double pole for 208 or 240 volt.

2.04 ENCLOSURES

A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the drawings:
   1. Indoor: NEMA 1, steel.
   2. Outdoor, corrosive or wet location: NEMA 4X, stainless steel.

2.05 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
   1. Arc-flash boundary.
   2. Flash hazard category (0-4).
   3. Minimum arc rating (cal/cm^2).
   4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide disconnect switches where indicated on the drawings.

B. Provide fuses in fusible disconnect switches where necessary and in accordance with Section 16475–Overcurrent Protective Devices.

C. Provide toggle switch for each single phase fractional horsepower motor where indicated on the Drawings.

D. Disconnects indicated to have auxiliary contacts shall have contacts by the disconnect manufacturer. Power to auxiliary contacts at field devices shall be removed when the disconnect is in the "Off" position.

E. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring (e.g. Mini-cas wiring) shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the Off position.

END OF SECTION

SECTION 16450

SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Power system grounding.
   2. Electrical equipment and raceway grounding and bonding.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

A. Ground each separately-derived system neutral to nearest effectively grounded building structural steel member on separate grounding electrode.

B. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.

1.03 SUBMITTALS

A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.

B. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 MATERIALS

A. Ground Rods: Copper bonded, 5/8-inch-diameter, minimum length 10 feet.

B. Ground Connections Below Grade: Exothermic type-Cadweld, or equal.

C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide a separate, insulated equipment grounding conductor in feeder circuits. Terminate each end on a grounding lug, bus, or bushing.

B. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, and structural reinforcing bars using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve.

C. Ground system, transformer neutrals and equipment as required by code and local ordinances.

D. All feeder neutrals shall be connected to neutral at only one point in the MCC or switchgear.

E. Water system grounds and a minimum of three ground rods at 15-foot separations near service entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.

F. All service entrance ground conductors shall be installed in PVC conduit.

G. Include ground for grounded receptacles, light fixtures, telephone system, motors, and equipment items shown on Drawings.

H. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.

I. Provide a separate grounding conductor system for the grounding of all lighting standards, installed in the same conduit as the branch circuit conductors.

J. All equipment in NEMA 4X areas that are fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.

3.02 MEDIUM VOLTAGE SYSTEM GROUNDING

A. Provide and install a 1/4-inch by 2-inch (minimum) ground bus 18 inches above finished floor with insulated standoffs 36 inches on center, completely around the perimeter of the room (vault) containing the high voltage switchgear and unit substations. Route bus over door(s). All connections to bus shall be bolted with Belleville washers and compression (tool applied) spade lugs or Exothermic.

B. Provide six ground rods equally spaced around high voltage switchgear room. Connect to ground bus with 4/0 copper. Exothermic connection shall be made between conductor, ground rod and ground bus.

C. Provide separate 4/0 copper conductor from ground bus to:
   1. XO terminal of each transformer.
   2. Each high voltage switch ground bus.
   3. Secondary service equipment ground bus.
   4. Transformer high voltage grounded terminal (if required).

D. Provide full size 600V copper THHN/THWN or XHHW-2 grounding conductor in each conduit, raceway or enclosure which contains high voltage conductors. Terminate at ground bus of equipment containing high voltage terminations. Connect to ground rod and grounding conductor in manhole.

E. Bond each enclosure containing high voltage parts (switches, fuses, transformers, pull boxes, etc.) to room ground bus with 4/0 copper conductor.

F. Bond all conduits containing high voltage conductors or secondary service conductors to penetrated enclosures using grounding bushing and 4 AWG copper conductor. Attach to penetrated enclosures using grounding bushing and 4 AWG copper conductor. Attach to penetrated enclosure using compression lug on stud or bolt and Belleville washers.

G. Bond all conduits carrying individual grounding or grounding electrode conductors with grounding bushing and separate #4 copper grounding conductor to ground bus.

H. Provide No. 10 stranded wire from each termination shield drain wire to ground bus within enclosure. Connect to nearest grounded conductor if ground bus is not within 24 inches. Route shield drains away from energized parts. Make connections with "Sta-Kon" type terminals or tool applied tap connectors.

I. Provide ground rod in each section of each secondary switchboard. Make Exothermic or UL Listed Mechanical connection between 4/0 copper to ground rod and to switchgear/switchboard ground bus.

J. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

3.03 TESTING

A. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three point "fall of potential" test. The test results shall include a graph of the results, plus a diagram of the testing layout. A single point of measurement is not acceptable, and the two point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms.

B. The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or approved equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test report.

C. Individual ground rods when tested separately shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.

D. Multiple ground rod grids shall be isolated from all metallic connections, such as from grid under test to other grounded structures and electrical system neutrals.

E. Provide test report using the attached form, 16450-1. Each ground grid, including service entrance transformers, switchgear, etc., shall have a form submitted.

END OF SECTION

FORM 16450-1

GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE _____

2. PROJECT NAME _____

3. LOCATION OF TEST _____

4. DRAWING NO. _____

5. GROUND ROD TYPE _____

   DIAMETER _____

   LENGTH _____

6. TEST METHOD _____

   INSTRUMENT TYPE _____

   SERIAL NO. _____

7. REQUIRED MAXIMUM RESISTANCE TO EARTH _____

8. MEASURED RESISTANCE TO EARTH

   ROD 1 _____

   ROD 2 _____

   ROD 3 _____

TEST PERFORMED BY: _____
Signature

TEST WITNESSED BY: _____
Signature

SECTION 16460

TRANSFORMERS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Distribution transformers for nonlinear loads.
   2. Dry-type transformers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NEMA ST 1–Specialty Transformers.

B. ANSI/NEMA ST 20 – Dry-Type Transformers for General Applications.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.

D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.

E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute and other standards pertaining to material, construction, and testing, where applicable.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 25%, 50%, 75%, and 100% rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products under provisions of Section 01600–Materials and Equipment.

B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.

C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Square D.

B. Cutler Hammer.

C. Substitutions: Under provisions of the General Conditions.

2.02 DRY-TYPE TRANSFORMERS

A. Dry-Type Transformers: ANSI/NEMA ST 20; factory-assembled, air-cooled, dry-type, two-winding, ventilated transformers; ratings as shown on the Drawings. Transformers shall be TP-1 rated.

B. Insulation system and average winding temperature rise for rated KVA as follows:

KVA Rating	Class	Temperature Rise (°C)
1-500	220	115

C. Case temperature shall not exceed 35°C rise above ambient at its warmest point.

D. Wiring Taps, Transformers Less than 15 KVA: Two 5% below rated voltage, full-capacity taps on primary winding.

E. Winding Taps, Transformers 15 KVA and Larger: ANSI/NEMA ST 20.

F. Sound Levels: ANSI/NEMA ST 20.

G. Basic Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger.

H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

I. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

J. Coil Conductors: Continuous copper windings with terminations brazed or welded.

K. Enclosure: ANSI/NEMA ST 20; NEMA Type 2. Provide lifting eyes or brackets.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Include engraved metal nameplate from manufacturer with transformer connection data. Also provide engraved phenolic nameplate as specified in Section 16195–Electrical Identification.

2.03 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
1. Arc-flash boundary.
2. Flash hazard category (0-4).
3. Minimum arc rating (cal/cm^2).
4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install equipment per manufacturer's recommendations and as indicated on the drawings. Coordinate final locations of equipment with CONTRACTOR, and review final locations with ENGINEER prior to setting equipment.

B. Protect equipment during installation to prevent twisting or deformations, exposure to potentially damaging environments, and work of other trades. Maintain protection until completion of construction.

C. Set transformer plumb and level.

D. Use liquid-tight flexible metal conduit, 3 feet maximum length, for connections to transformer case. Make conduit connections to side panel or bottom of enclosure only. Provide grounding as required by code.

E. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

3.02 ADJUSTMENTS AND CLEANING

A. Immediately prior to final inspection, make final adjustments and thoroughly clean all equipment. Refinish all damaged enclosures to original quality.

3.03 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate adjustments.

C. Visually inspect all equipment and components at time of delivery. Submit report to ENGINEER with list of items to be corrected.

D. Electrically test and inspect all equipment. Work to be done by recognized agency. Submit final report to ENGINEER. Adjust or replace equipment to comply with manufacturer's specifications and resubmit corrected test report. Testing shall be done in accordance with NETA testing specifications for equipment supplied.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Lighting and appliance panelboards.
   2. Power distribution panelboards.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical equipment installation work similar to that in this project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.

D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.

E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material, construction, and testing, where applicable.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All electrical equipment and material shall be received and stored with the factory tamper-proof wrapping intact. Provide factory-wrapped waterproof flexible barrier material for factory-packaging of equipment and material to protect against physical damage in transit. Do not install damaged equipment or material; remove from project site. Store equipment in factory coverings in a clean, dry indoor space which provides protection against weather.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Square D.

B. Cutler-Hammer.

C. Substitutions: Under provisions of the General Conditions.

2.02 PANELBOARDS

A. Lighting and appliance and power distribution panelboards shall be provided as indicated on the drawings and as scheduled. Panelboards shall be factory assembled and constructed in accordance with latest NEMA, UL, and NEC requirements and shall bear the UL label. Panelboard cabinets, including boxes and fronts, shall be code gauge galvanized steel. Front covers shall be hinged to allow access to wiring gutters without removal of panel trim. All fronts shall be complete with cylinder-type lock and catch, and all cylinders shall be keyed alike. Provide two keys per panelboard to OWNER.

B. Gutter and wiring space shall be provided according to NEMA and UL standards, except provide additional 6-inch-wide or high wiring space for all double-lugged two or more section panels, feed-through panels; or panels which subfeed other panels at 100 amperes or more. CONTRACTOR shall instruct manufacturer as to where additional wiring space is needed, i.e., top, bottom, right, left, or combination. Where oversized cabinets are necessary for one section of a panelboard, all sections of the panelboard shall be the same size.

C. Panelboards shall have full ampacity bussing throughout and shall be full-size in regard to number of possible pole spaces. All lighting and appliance panels shall have 42 poles per section, except where shown to be less. Power distribution panels shall have number of poles as scheduled. Panelboards shall be identified with phases reading left to right and circuits alternately numbered left to right, odd numbers on the left, even numbers on the right.

D. Panelboards shall have copper bussing. Provide copper ground buss in all panelboards.

E. Lugs for incoming feeders shall be UL listed for use with copper conductors. Lugs shall be sized by CONTRACTOR in accordance with feeder sizes shown. Main lugs or main breakers shall be top or bottom mounted to coordinate with incoming feeder entrance location. Location shall be selected by CONTRACTOR.

F. Circuit breakers shall be quick-make, quick-break, with thermal magnetic trip bolt-on-type. Multipole breakers shall have common internal trip, UL listed as multipole units; handle ties are not permitted. All breakers shall be of the same manufacturer as the panelboard and provided at ampere capacity as scheduled.

G. Lighting and Appliance Panelboards shall be provided as follows (types listed are Cutler-Hammer):

Type	Maximum Voltage	Maximum Bus Amps	Maximum Brk. Amps	Minimum I.C.
Pow R-Line 1a	240	400	100	10,000
Pow R-Line 2a	277/480	400	100	14,000
Pow R-Line 3a	600	800	225	14,000
Pow R-Line 4B	600	1,200	1,200	14,000

H. All panelboards scheduled with main circuit breakers shall be individually mounted main circuit breaker panels. Main circuit breakers installed in the location of branch circuit devices (branch mounted mains) are not acceptable.

I. Panelboards that are called out to be rated for nonlinear loads shall be Square D Model NQOD, or equal.

J. Provide spare parts as described in Section 16951–Spare Parts.

2.03 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
1. Arc-flash boundary.
2. Flash hazard category (0-4).
3. Minimum arc rating (cal/cm^2).
4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which work is to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Panelboards shall be provided as indicated. Final locations, sizes, and mounting of panelboards shall be reviewed with ENGINEER prior to installation.

B. Each panelboard shall have a typewritten circuit schedule provided on the inside cover. This schedule shall be covered with clear plastic in a metal frame and shall include room numbers, room name, and area or item served by each branch circuit. Room numbers used shall be those used by OWNER, except as otherwise requested by ENGINEER.

C. Flush panels in finished areas shall have factory applied primer coat painted trim for finish painting by CONTRACTOR to match the walls.

D. Prior to final inspection, clean all panelboard interiors, adjust trims, covers, hinges and locks, and refinish covers to original condition.

E. Panel trim to have enamel finish, as selected by OWNER.

F. Balance load on all panelboards so phases are balanced to 15% of each other. Reconnect or redistribute circuits and/or circuit breakers to achieve balanced condition. Submit ammeter readings for all panelboard feeders indicating normal operating load and phase balance.

END OF SECTION

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I^2t curves, and manufacturer's detailed specifications.

1.03 QUALITY ASSURANCE

A. Comply with the following requirements:
   1. NFPA 70 National Electrical Code (NEC).
   2. Local codes and ordinances.
   3. Provide overcurrent protective devices by same manufacturer for each type of device.

1.04 SPARE PARTS

A. Provide the following spare parts to OWNER that match items specified:
   1. In three phase circuits: Three fuses of each type and rating.
   2. In single phase circuits: Two fuses of each type and rating.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01600–Materials and Equipment.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

PART 2–PRODUCTS

2.01 FUSES

A. General purpose fuses for protection of motors, transformers, feeders, and main service:
   1. Use UL Class RK-1 fuses:
      a. Single end rejection or to fit mountings specified.
      b. 0-600 ampere rating.
      c. 200,000 ampere interrupting capacity.

d. Dual element, time delay.
e. Use Bussman Low Peak LPN-RK, or equal: 250 volt rating.
f. Use Bussman Low Peak LPS-RK, or equal: 600 volt rating.

2. Use UL Class L fuses:
a. Bolt-in type.
b. 601-6,000 ampere rating.
c. 200,000 ampere interrupting capacity.
d. Time delay.
e. Use Bussman HI-CAP, KRP-C, or equal: 600 volt rating.

B. General purpose fuses for protection of motor control circuits, lighting ballasts, control transformers, and street lighting fixtures:
1. Use UL Class CC, fast acting, single element fuses.
2. Rated for 0-30 amperes.
3. Provide 200,000 ampere interrupting capacity.
4. Use Bussman Limitron KTK-R, or equal: 600 volt rating.

C. All lugs shall be rated to accept copper conductors.

2.02 CIRCUIT BREAKERS

A. General:
1. Comply with UL 489 and NEMA AB1 requirements.
2. Provide thermal and magnetic protection unless noted otherwise.

B. Main (service entrance) or Feeder Breakers:
1. Configuration shall be inverse time automatic tripping.
2. Field-adjustable trip circuit breaker: NEMA AB1; provide circuit breakers with frame sizes 200 amperes and larger with mechanism for adjusting long-time short-time continuous current short-time/long-time pickup setting for automatic operation. Range of adjustment: seconds amperes percent.
3. Field-changeable ampere rating circuit breakers: NEMA AB1; provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.
4. Solidstate circuit breakers: Provide circuit breaker as scheduled with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide ground fault trip with integral ground fault setting, zero sequence type ground fault sensor, instantaneous trip, and adjustable short-time trip.

C. All lugs shall be rated to accept copper conductors.

2.03 ENCLOSURES

A. Provide fused switch or circuit breaker with enclosures, where required, as listed below unless noted otherwise on the Drawings:
1. Indoor: NEMA 1, steel.
2. Outdoor, corrosive, or wet location: NEMA 4X, stainless steel.

2.04 ACCESSORIES

A. Provide accessories as scheduled as listed below:
1. Undervoltage trip device: 120 volts AC.
2. Auxiliary switch: 120 volts AC.

3. Alarm switch: 120 volts AC.
4. Handle lock: Include provisions for padlocking.
5. Provide mechanical trip device.

2.05 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
1. Arc-flash boundary.
2. Flash hazard category (0-4).
3. Minimum arc rating (cal/cm^2).
4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, four-inches by six-inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

3.02 ADJUSTMENT

A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

SECTION 16480

MOTOR CONTROL

PART 1–GENERAL

1.01 SUMMARY

A. Work Included:
   1. Motor control devices, accessories, and general requirements.
   2. Manual motor starters.
   3. Magnetic motor starters.
   4. Motor control centers.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. ANSI/NEMA ICS 6–Enclosures for industrial controls and systems.

B. NEMA AB 1–Molded case circuit breakers.

C. NEMA ICS 2–Industrial control devices, controllers, and assemblies.

D. NEMA KS 1–Enclosed switches.

E. NEMA PB 1–Panelboards.

F. NEMA PB 1.1–Instruction for safe installation, operation, and maintenance of panelboards rated 600 volts or less.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01300–Submittals.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 DELIVERY, STORAGE, AND HOLDING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.06 SPARE PARTS

A. Furnish spare parts for equipment specified herein as listed in Section 16951–Spare Parts.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Motor control devices, motor starters, variable frequency drives, and motor control centers shall be as manufactured by Allen Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.

B. The Drawings and specifications were prepared based on Allen Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or specifications by ENGINEER.

2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.

B. Pushbuttons: NEMA ICS 2; heavy-duty, oil-tight, (30 mm) as shown on the Drawings.

C. Indicating Lights: NEMA ICS 2; heavy-duty, oil-tight, (30 mm), push-to-test type as shown on the Drawings.

D. Selector Switches: NEMA ICS 2; heavy-duty, oil-tight, (30 mm) as shown on the Drawings.

E. Relays: NEMA ICS 2; with LED indicator.

F. Timing Relays: UL Listed with On and Timing Out LEDs.

G. Control Power Transformers: 240/120 volt secondary.

H. Elapsed Time Meters: Redington/Engler 710 series, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.

I. All starters shall be equipped with the auxiliary devices to meet the requirements of the plans and specifications. Each starter operating at other than 120 volt single phase shall be equipped with a control transformer providing 120 volt secondary for control power. Transformer shall have fused primary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all starters shall be 120 volts.

J. Wall-Mounted and MCC Enclosures: NEMA ICS 6:
   1. Enclosures in indoor, dry locations shall be NEMA 1 gasketed.
   2. Enclosures in outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.
   3. Starters and disconnect devices for motors shall be installed in common enclosures, combination type, with all accessories such as push-to-test pilot lights and H-O-A switches, mounted in the enclosure fronts.

2.03 MANUAL MOTOR STARTERS

A. Integral Horsepower Motor Starter: NEMA ICS 2; AC general purpose, Class A, manually operated, full-voltage controller for induction motors rated in horsepower, with manual reset overload relay, low voltage protection, green pilot light, NO and NC auxiliary contact, and toggle operator. Size based on actual motor full load current.

B. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with manually reset thermal overload unit, green pilot light, and toggle operator.

C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for induction motors rated in horsepower, without thermal overload unit, green pilot light, NO and NC auxiliary contact, and toggle operator.

2.04 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solidstate overload relay, Allen Bradley SMP-1, or equal. Starters for submersible pumps and mixers shall be SMP-2, or equal.

B. Full-Voltage Starting: Reversing or Nonreversing type as shown on the Drawings.

C. Coil Operating Voltage: 120 volts, 60 Hz.

D. Size: NEMA ICS 2; size based on actual motor full load current.

E. Overload relays shall have the following features:
   1. Self-powered.
   2. Up to 3:2:1 adjustments.
   3. Visible trip indicators.
   4. Phase loss protection.
   5. Low energy consumption.
   6. Ground fault protection (submersible applications).

F. Combination Motor Starters: Combine motor starters with molded case circuit breakers.

G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers and combination motor starters.

2.05 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

A. Molded Case Thermal-Magnetic Circuit Breakers: NEMA AB 1; circuit breakers with integral thermal and instantaneous magnetic trip in each pole, according to Drawings.

B. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.

C. Nonfusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position.

D. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position. Fuse Clips: Designed to accommodate Class R fuses.

2.06 MOTOR CONTROL CENTERS

A. Starters and disconnect devices for motors shall be installed in motor control centers, except where shown to be remote mounted at the motor location. Starters and disconnect devices shall be NEMA rated, sized according to application as specified. All starters and motor control centers shall be manufactured by Allen Bradley, or equal. To assure proper coordination between Section 16940–Controls and Instrumentation, supplied equipment, and the motor control centers, the MCC and NEMA Class IIB drawings shall be supplied as part of the Controls and Instrumentation package described in Section 16940–Controls and Instrumentation. MCC drawings provided by the MCC manufacturer will not be accepted as shop drawing submittals or O&M documents. System Supplier described in Section 16940–Controls and Instrumentation shall wire and test all MCCs for the functions described herein in their shop prior to shipment to the site. Provide one copy of the test report to ENGINEER.

B. It shall be assumed that colors will be selected by OWNER and shall be nonstandard.

C. Auxiliary contacts shall be of quantity necessary for equipment functions.

D. Motor Control Center design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.

E. Structures shall be totally enclosed dead front, free standing assemblies, 90 inches high and not less than 20 inches deep for front mounted units and not more than 20 inches deep for units mounted back-to-back.

F. Each structure shall contain a main horizontal bus with rating as specified, and vertical buss feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical buss of all MCC sections shall be

powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a ground buss. All buss shall be tin-plated copper and braced to withstand short-circuit currents as indicated.

G. Structures shall contain a horizontal wire-way at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and safely accessible without disrupting service.

H. A vertical wireway with a minimum of 28 square inches of cross sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wire-ways shall be free of all live parts and shall contain cable supports.

I. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.

J. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.

K. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical buss; no wiring to these stabs shall extend into the bus compartments.

L. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory wired.

M. Control centers shall be NEMA Class II.

N. Wiring in Control Centers shall be Type B.

O. Provide neutral landing lugs for all motor control centers accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground buss at the utility service entrance, unless otherwise noted.

P. Control Centers shall include NEMA 1 gasketed enclosures, unless otherwise noted.

Q. Remote mounted controls shall be heavy-duty, oil-tight (30 mm) of same quality and type furnished in starters and as shown on the Drawings. Equipment controls that require a manual reset shall be accomplished through a reset pushbutton on the enclosure or motor control center bucket for the associated piece of equipment.

R. Motor control center enclosures must be in accordance with area designations shown on Drawings.

S. All lighting and small power transformers shall be dry-type, Class H insulation, 80°C rise (KVA as indicated on Drawings). Coil windings shall be glass taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480 volt primary, Delta with 120/240 volt, single phase, 3 wire secondary, unless indicated otherwise.

T. All lighting panelboards shall be Cutler Hammer Pow R-Line 1a, or equal, with 10,000 amp interrupting capacity, at 120/240 volt, single phase, 3 wire with branch breakers as shown on Drawings, unless indicated otherwise. Branch mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be copper.

U. All motor control centers shall be factory assembled, wired, and tested. All internal wiring shall be color coded, numbered, and each wire shall be terminated on terminal strips. Schematic and wiring layout drawings, following JIC Standards, which show all connections to external devices, a complete bill of materials, and a detailed description of operation shall be submitted for each piece of equipment.

V. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.

W. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be mechanically fastened. Nameplates located indoors shall be adhesive type.

X. Unless otherwise indicated, all conduit entrances shall be through the bottom only.

Y. Motor Control Center interrupting rating shall be as shown on the Drawings, minimum 42,000A.

Z. The main service breaker or main lugs of each MCC shall be provided with a surge protection device and a 3 phase monitor. This surge protection device shall be on the load side of the main and be an MCG Electronics, Inc., or equal. The 3 phase monitor shall be on the load side of the main and be Timemark *269, or equal. CONTRACTOR to select voltage to match electrical service.

AA. Main Breaker: Molded case circuit breaker, 3 pole, as shown on the Drawings with lugs for 480 volt, 3 phase, 4 wire, 60 cycle entrance. Breakers noted on the Drawings to be 100% rated shall be as such. When main breaker is the disconnecting means for a structure, breaker shall be service entrance rated.

2.07 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers of shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
   1. Arc-flash boundary.
   2. Flash hazard category (0-4).
   3. Minimum arc rating (cal/cm^2).
   4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, 4 inches by 6 inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

A. Provide motor control equipment in accordance with manufacturer's instructions and Drawings.

B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.

C. Provide fuses in fusible switches.

D. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the Drawings is not acceptable. If power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current due to improved power factor.

E. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.

F. Motor Data: Provide neatly typed label inside each motor starter enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.

G. Provide disconnect device for all motors in accordance with applicable codes and as specified. Final location shall be determined in the field.

H. All motors will be provided by other divisions, ready for connections. This contractor shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.

I. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, disconnect switches, etc.

J. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits.
   1. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material, flame-retarded per IPCEA S-19-81 and IEEE-383-1974 to cover the connection area, and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Bolt connection area shall be kept free of mastics and fillers to facilitate rapid stripping and reentry.
   2. Motor connections shall be suitable for continuous operation at conductor temperatures of 90°C.
   3. Motor connection kits shall be as manufactured by Raychem Corporation, or equal.

K. Provide motor starters as specified for all motors, unless shown or specified that starters or control equipment will be furnished by others.

L. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

SECTION 16500

LIGHTING

PART 1–GENERAL

1.01 SUMMARY

A. Work includes a complete functional lighting system.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 REFERENCES

A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the "UL" label where practicable. In all cases the lighting fixtures shall be constructed with "UL" listed components.

B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.

D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.

1.03 SYSTEM DESCRIPTION

A. Intent: It is the intent of these specifications to obtain a completed lighting fixture installation by CONTRACTOR. Completed means lamped, cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.

B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

C. Provide lamps for all fixtures of size and type as recommended by the fixture manufacturer and as scheduled.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals. Shop drawings shall include, but not be limited to, the following:

1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, pre-finishes, metal thickness, fabrication methods, support method, ballasts, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents. Manufacturers' catalog cut sheets will not be acceptable.
2. Installation instructions.
3. Certified test data and reports.
4. Maintenance and operating instructions.
5. Shop drawings shall not only clearly indicate the assigned fixture type but also the equipment location.
6. Provide a submittal on all lamp types used. Submittal should include but not be limited to, lumen output, lamp color temperature, and CRI value.

B. Submit for review samples requested by ENGINEER. The fixtures or components are to be tagged with the project name and the fixture type. Samples will be held by CONTRACTOR available for reference throughout the construction period. Fixtures or components under the contract shall be identical with the accepted samples. No sample (fixture or component) is to be installed on the Project.
1. In the event the submissions are disapproved, the materials will be returned to CONTRACTOR to immediately make a new submission responding to the notations (corrections/revisions) of ENGINEER regarding compliance with the Contract Documents.
2. All charges for these shipments shall be prepaid by CONTRACTOR.
3. The fixture schedule shows the style of the fixture only. CONTRACTOR shall verify the types of ceiling construction prior to releasing fixtures for fabrication and delivery and provide fixtures adapted to the ceiling construction used.

1.05 QUALITY ASSURANCE

A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.

B. Warranties: CONTRACTOR shall warrant all work under this section to be free from defects in materials and workmanship for a period of one year from the acceptance of the lighting system. CONTRACTOR shall secure and provide to OWNER manufacturer's warranties for ballasts and other such component items.

C. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.

D. Photometric Testing: Samples may be necessary to be subjected to photometric testing at the request of ENGINEER. Luminaire efficiency shall be determined in an integrating sphere not less than 100 inches in diameter. Testing will be at CONTRACTOR's expense.

E. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.

F. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

1.06 SPECIAL FIXTURES

A. Special Fixtures: Designs and/or unique applications of standard units may need samples and mock-ups and other developmental work which is to be specifically provided for in CONTRACTOR's Bid.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices, lamps, and components necessary for the proper operation of the equipment.

B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.

C. Timely Purchasing: Luminaires and associated lamps and other allied equipment shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

PART 2–PRODUCTS

2.01 FABRICATION

A. Materials: Provide dimensional thickness of metal, plastic, and composite materials so that all fixtures are rigid, stable, and will resist deflection, twisting, and warping under normal installation and relamping procedures.
   1. All luminaire housings minimum 22 gauge cold rolled steel, unless a heavier gauge is specified.
   2. All aluminum extrusion housings minimum 3/16-inch-thick.
   3. All spun, hydroformed, or sheet aluminum reflectors fabricated from #12 aluminum sheets minimum, 15 gauge (0.57-inch) or heavier.
   4. All acrylic and polycarbonate lenses and/or diffusers minimum 1/8-inch nominal thickness.

B. Joints: Provide positive, durable, means of connection at all joints. NO HOLLOW RIVETS shall be used.

C. Gaskets: Provide neoprene, silicone, rubber, or other appropriate gasketing, stops, and barriers where required to prevent light leak, control sound and vibration, prevent water leaks, and if pertinent, water vapor penetration.

D. Edges: Provide finished product with the following minimum qualities:
   1. Ground and/or burr-free metal edges.
   2. Tight fitting connections, hinges, and closures.

3. Clean neat corners, edges, trims, and frames.

E. Castings: All cast parts, including die-cast members, shall be of uniform quality; free from blow holes, pores, hard spots, shrinkage defects, cracks, or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.

2.02 FINISHES

A. Application: Fixture finishes shall be applied in a manner that will assure a durable wear-resistant surface:
   1. Prior to finishing, all surfaces must be free from foreign materials such as dirt, rust, oil, polishing compounds, and mold release agents.
   2. All castings and extrusions shall be machined, sanded, or similarly treated and given minimum one coat of baked-on clear methacrylate lacquer, unless a painted finish is specified.
   3. Aluminum surfaces exposed to weather (other than anodized reflectors covered elsewhere) receive a duronodic or polyester powder paint finish as specified for corrosion resistance.
   4. Sheet steel fixture housings, iron and steel parts, which have not received phosphating treatment ("Bonderizing" or similar process) or are to be utilized in exterior applications, are to be made corrosion resistant by zinc or cadmium plating or hot-dip galvanizing.
   5. Unless specified to the contrary, all fluorescent fixture housings shall have a complete coverage of white alkyd reflecting enamel, 85% minimum reflectivity, applied by either a spray or dip process, then baked in a temperature controlled oven until paint is thoroughly cured. Prior to applying the enamel, each metallic surface shall be prepared for painting by using a five-stage hot zinc phosphatizing process.
   6. Plastic refractors diffusers material shall be light-stable 100% virgin acrylic, translucent (98% minimum transmission), unless specified otherwise, conforming to minimum standards of IES-NEMA-SPI. Material shall perform as applied in a normal interior environment for a period of 20 years without noticeable deformation and with a transmission loss not exceeding 5%. Nominal thickness of material shall be 0.125-inch for either extrusions or injections.

2.03 LAMPS

A. Lamps: Provide new lamps as specified for all lighting fixtures (luminaires) as shown on the Contract Drawings.

B. Incandescent Lamps:
   1. All incandescent lamps shall be of the same manufacturer.
   2. Incandescent lamps exposed or installed in open-type fixture without lenses or refractors shall be 125 volt inside frosted-type, A-shape.
   3. Incandescent lamps installed in fixtures having lenses or refractors shall be 125 volt, clear type, A-shape.
   4. Where fixtures are scheduled for PAR or R reflector-type lamps, provide medium flood type, 125 volt lamps.

C. Fluorescent Lamps:
   1. All fluorescent lamps shall be of the same manufacturer.
   2. All fluorescent lamps shall be 3500 K color temperature.
   3. Color Rendering Index (CRI).

a. Compact fluorescent lamps shall have a minimum CRI rating of 82.
b. Linear fluorescent lamps shall have a minimum CRI rating of 86.

4. Lamps shall be of the wattage specified on the drawings.

D. High Intensity Discharge (HID) Lamps:
1. All HID lamps shall be of the same manufacturer.
2. HID lamps shall have a minimum CRI rating of 82.
3. Lamps shall be clear, base up or down burning to suit application.

E. Lamps shall be manufactured by Phillips, Sylvania Osram, or equal, wattage as indicated on the drawings.

2.04 LAMP HOLDERS

A. Screw Base: Screw base sockets for incandescent and mercury vapor lamps shall be of heavy-duty heat-resistant porcelain with spring center contacts and plated screw shells.

B. Fluorescent Sockets: Fluorescent lamp sockets operating with an open circuit voltage in excess of 300 volts shall be of the safety-type that open the supply circuit when the lamp is removed from the sockets.

C. All fluorescent fixtures installed that have no glass or metal enclosure shall be equipped with safety-type lamp holders so that lamps shall not become dislodged from the holders.

2.05 WIRING

A. Minimum Standards: All wiring shall comply with the following standards.
1. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 16120–Wire.
2. Wiring between fluorescent lamp holders and associated operating and starting equipment shall be of similar or heavier gauge than the leads furnished with the ballasts.
3. Wire leads to the receptacle or connector of any side prong incandescent lamp, or any "cool-beam" lamp, or any lamp 200 watts or over shall be SF-2 (silicone rubber insulated) stranded wire.
4. Wiring within fixture construction is to be concealed, except where the fixture design or mounting dictates otherwise.
5. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
6. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

2.06 LAMP BALLASTS

A. Fluorescent Electronic Ballast:
1. Fluorescent Ballast: Shall meet UL Standard 935. Ballasts shall be PROGRAM RAPID START (PRS) type.
2. Ballasts shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The input current 3rd harmonic content shall not exceed 13% of the input current. The total harmonic distortion shall not exceed 10%.
3. Fluorescent ballasts shall conform to the performance criteria listed below:

Ballast	Nominal Lamp Watts	Max. Input Watts (ANSI)	Minimum Ballast Factor
1-F32T8	32	29	0.85
2-F32T8	32	58	0.85
3-F32T8	32	89	0.85
All others			0.85

4. Luminaires designed as multi-level switching shall have a combination of 1, 2, or 3 lamp ballasts configured to allow switching of all inboard lamps as a group separate from outboard lamps in the room. Master/slave luminaire arrangement is acceptable. CONTRACTOR shall verify ballast configuration to achieve switching shown prior to submittal.
5. Ballasts shall be universal voltage. The ballast must maintain constant high output through the entire input voltage ranges of 120 volt to 277 volt.
6. Ballast Requirements:
   a. Current crest factor shall be no greater than 1.8 for F40 lamps and 1.7 for all other lamps.
   b. The operating ambient temperature range shall be 50°F to 105°F.
   c. Fluorescent ballasts shall operate at 20kHZ or higher, with no detectable lamp flicker.
   d. Four lamp ballasts shall operate parallel circuit lamps that allow remaining lamps to maintain full output if companion lamps fail.
   e. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.
   f. Ballast power factor shall be greater than 95%.
   g. Ballast shall be rated Class P, thermally protected and have a Class A sound rating, or better.
   h. Ballast shall comply with EMI and RFI limits set by FCC (CFR 47 Part 18).
   i. Ballasts shall carry a three-year warranty including labor allowance.
   j. Program rapid start ballasts shall heat the filament prior to applying the starting voltage to the lamp, then remove lamp cathode heat.
   k. Cold weather ballast(s) must reliably start and operate lamps in ambient temperatures down to 0°F for the rated life of the lamps.

B. Compact Fluorescent Electronic Ballasts:
   1. Fluorescent Ballast: ANSI C82.1; high power factor type, Class P with voltage rating matching branch circuit voltage. Ballast factor shall be .85 or greater.
   2. Current crest factor shall be no greater than 1.7. Ballast shall have a Class A sound rating.
   3. Ballast shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The total harmonic distortion for lamp wattage <26 watts shall not exceed 33%; all others shall not exceed 10%.
   4. Ballast shall have lamp fault shut off circuitry to prevent starting of a faulty lamp.
   5. Ballasts shall operate at a frequency of 20 kHZ or higher with no detectable lamp flicker.
   6. Cold weather ballast must reliably start an operate the lamp in ambient temperatures down to 0°F for the rated life of the lamp.

C. High Intensity Discharge Ballasts:
   1. HID Ballasts:
      a. Comply with ANSI C82.4, C82.6 and C92.1.

b. High Pressure Sodium: High power factor constant wattage auto-transformer for lamps 150 watts and above. High power factor, high reactance auto-transformer for lamps less than 150 watts.
c. Metal Holder: Lead-peaked auto-transformer-high power factor for lamps above 150 watts. High reactance auto-transformer-high power factor for lamps 150 watts and below.
d. Metal Halide Pulse Start: Super constant wattage auto-transformer with igniter and a maximum crest factor of 1.5.
e. The ballast design center shall not vary more than ±5% from rated lamp walls for nominal line voltage and nominal lamp voltage.
f. With a nominal voltage "reference" lamp, the wattage regulation spread shall not exceed 20% for ±5% line voltage variation for high reactance auto-transformer; high power factor ballasts and 30% for ±10% line voltage variation for high power factor auto-regulator ballast.
g. Ballasts must reliably start and operate the lamp in ambient temperatures down to -20°F for the rated life of the lamp. The ballast primary current during starting for high reactance auto-transformer type ballasts may exceed the normal operating current by a factor of 1.5 for 250-1000 watt lamps. Auto-regulating type ballasts shall not exceed normal operating current.
h. High reactance autotransformer-high power factor ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 20% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.
i. Auto-regulating high power factor ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 40% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.
j. For high reactance auto-transformer-High power factor ballasts, the current crest factor shall not exceed 1.6 for ±5% line voltage variation, including lamp starting or from nominal lamp voltage through rated end of life lamp voltage.
k. For auto-regulating high power factor ballasts, the current crest factor shall not exceed 1.8 for ±10% line voltage variation, including lamp starting or from nominal lamp voltage through rate end of life lamp voltage.
l. For high reactance auto-transformer: High power factor ballasts, the line power factor of the lamp/ballast system shall not be below 90% for ±5% line voltage variation.
m. For auto-regulating high power factor ballasts, the line power factor of the lamp/ballast system shall not be below 90% for ±10% line voltage variation.
n. LS-NC Rating: NEMA LE-2, equal to or less than ratings listed in Table C-1.
o. Two-year warranty.

D. Acceptable Manufacturers: Ballasts made by the following manufacturers will be accepted:
1. General Electric.
2. Universal.
3. Advance.
4. Motorola.

E. Emergency Fluorescent Ballasts:
1. Emergency ballast shall operate lamps at 60% output for minimum of 90 minutes.
2. Field replaceable. Nickel-cadmium battery.
3. Installed inside luminaries.
4. Solid state charging.
5. Battery to be recharged within 24 hours.

6. Remote battery test switch.

2.07 MARKING OF FIXTURES

A. Voltage Identification: Fixtures designed for voltages other than 110 to 125 volts circuits shall be clearly marked.

B. Lamp Types: Fixtures equipped with ballasts, etc., for operation of rapid start lamps shall be plainly marked "Use Rapid Start Lamps Only." Similarly, fixtures equipped with ballasts, etc., for operation of instant start or other type lamps shall be plainly marked. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

2.08 FIXTURE TRIMS

A. Trim Details: Provide trim details as shown on the Drawings or as specified. The trim finish and dimensions are subject to the shop drawing approval of ENGINEER.
   1. Mitered corners shall be smoothed before shop finish is applied. No lapping of trim metal for all flush mounted ceiling trims for rectangular or square recessed fixtures.
   2. All exposed ceiling trim and inside reveals on all fixtures shall be painted in a color to match the Architect's sample.

PART 3–EXECUTION

3.01 INSTALLATION

A. Install fixtures, lamps, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.

B. Lamps installed for use as temporary lighting shall be replaced with new lamps.

C. All wall mounted fixtures and all ceiling mounted surface fixtures including exit lights shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.

D. All fixtures shall be securely and adequately supported and installed. Recessed lighting fixtures in suspended ceilings or in plaster ceilings shall have channel and supports provided by CONTRACTOR as described in the finish section of these specifications. This Contractor shall provide plaster frames.

E. Surface or pendant mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fluorescent fixtures shall be supported by not less than two supports for each fixture. Where fluorescent fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly to the structure by a minimum of 3/8-inch rod inside EMT or rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed in addition to other support means. Cable to be 3/16-inch airplane cable. All fittings and connectors shall be compression-type. Cables must be secured to the superstructure and to a point or points on the fixture to ensure against falling parts.

F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room should be located at the height of the lowest fixture but not lower than 8 feet 0 inches A.F.F. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after installation of other equipment.

G. Recessed fixtures in suspended ceilings shall have final connections made up of a length of flexible conduit, not in excess of 48 inches, with THHN conductors, and green wire ground conductor.

H. Provide inscription for exit and stairway signs to conform to codes.

I. Metal decking shall not be pierced for fixture support.

J. All wiring for dimming circuits shall have an individual neutral provided for each circuit.

3.02 SUPPORTS

A. Mounting Frames: Provide mounting frames (plaster frames for example) as necessary for installation and as called for under other sections of these Contract Documents. Frames are to be finished matte white baked enamel unless otherwise noted.

B. Mounting Accessories: Provide bars, angles, or other attachment devices for all recessed fixtures. Fixtures shall be securely attached so there is minimum possible movement up, down, or sideways. Fixtures shall be mounted to permit access wiring. Fastening devices shall be of a positive, locking-type and will not require the use of special tools to apply or remove. Tie wires cannot be used in place of fastening devices.

C. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.

D. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the drawings and furnish appropriate mounting details for each lighting fixture.

E. Pendant Mounting: Provide pendant or surface mounted fixtures with required mounting devices and accessories, including hickeys, stud extensions, ball aligners, canopies, and stems. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the Drawings or established in the field.

F. Support: Adequate, sturdy support as necessary to prevent possibility of fixture falling. Surface and pendant fluorescent fixtures must be supported with two supports per 4-foot section, except that continuous 8-foot chassis shall have three supports. All pendants must have swivel aligners located at the top ends; pendants shall be 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the drawings, painted on job site. Support surface mounted fluorescent fixtures from structural members other than ceiling tees by providing Unistrut members laid across main ceiling tees or by attachment directly to structure.

3.03 ADJUSTMENT

A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units) shall be adjusted after dark under supervision of OWNER.

3.04 CLEANING

A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., are required to be installed prior to the finishing assembly which shall not be installed until the Project is "broom clean." When the fixture location or construction cannot permit sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.

B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

3.05 FINAL INSPECTION

A. Upon completion of the installation, lighting equipment must be in first class operating order and free from defects in condition and finish:
   1. At time of final inspection, all fixtures and equipment must be installed and lamped with new lamps and be complete with all lenses, diffusers, reflectors, side panels, louvers, or other necessary components.
   2. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
   3. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection shall be replaced at no expense to OWNER.
   4. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

SECTION 16610

EMERGENCY GENERATOR SET

PART 1–GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor materials, equipment and incidentals required, and install complete and ready for operation emergency generator set and emergency transfer switch as indicated on the Drawings and as specified herein.

B. The generator shall be provided skid mounted as an assembly. The generator shall be shipped ready for installation on a concrete base pad.

1.02 RELATED WORK NOT INCLUDED

A. Special requirements for equipment are included in Division 0.

B. Concrete work is included in Division 3.

C. Painting except as specified herein is included in Division 9, Section 09900.

D. HVAC work is included in Division 15.

1.03 DESCRIPTION OF SYSTEM

A. One diesel fueled emergency generator set, automatic transfer switch and all ancillary equipment will be installed at the Booster Pump Station to provide standby power.

1.04 QUALIFICATIONS

A. The equipment covered by these Specifications is intended to be standard equipment of proven ability as manufactured by a reputable manufacturer having long experience in the production of such equipment. The generator set furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. All equipment shall be provided through a single manufacturer. The generator set, transfer switch and ancillary equipment shall be as manufactured by Caterpillar or equal.

C. The electric generating system must meet all requirements of NFPA 110-1985 including design specifications, prototype tests, one-step full-load pickup, and installation acceptance.

D. The automatic transfer switch and all controls shall be the standard of the manufacturer, who is engaged in the manufacture of engine-generator sets, transfer switches, and accessories and has them available for sale on the open market. Control systems that are supplied by a sub-vendor or subcontractor of the vendor and not incorporated within the documentation drawings of the engine-generator manufacturer are not acceptable.

1.05 TESTING

A. The generator set shall receive the manufacturer's standard factory load testing. Prior to acceptance of the installation, equipment shall be tested to show it is free of any defects and will start automatically and be subjected to full load test.

B. A factory load test of the entire emergency power system, including engine, generator, transfer switch and all items contained in this specification section shall be performed at the manufacturer's factory. This test shall be for equipment actually supplied under this Contract. The factory test shall be as specified for field testing under C.3 below. Adequate notice of factory tests shall be given to the OWNER to be present for the tests.

C. Field Tests After Installation:
   1. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative(s) of the engine generator set supplier.
   2. Upon completion of initial start-up and system checkout, the supplier of the system shall perform a field test, with the ENGINEER notified in advance, to demonstrate load carrying capability and voltage and frequency stability.
   3. With the emergency load at normal operating level, a power failure is initiated by opening all switches or breakers supplying the normal power to the building or facility. Records shall be maintained throughout the tests of time-of-day, coolant temperature, canking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with all switches transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, battery charger rate at 5 minute intervals for the first 15 minutes, and at 15 minute intervals thereafter. Continue this load test for 6 hours observing and recording load changes and the resultant effect on voltage and frequency. Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cool down period and shutdown.
   4. Upon completion of the above test, allow the prime mover to cool for 5 minutes. Then apply full rated load (nameplate kW) consisting of building load supplemented by a load bank if required. Unity power factor is suitable for on-site testing, provided that rated load tests at power factor have been performed by the manufacturer prior to shipment. This full-load pickup shall be in one step immediately upon reaching rated r/min.

1.06 SUBMITTALS

A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with Section 01300. Submittals shall include at least the following:
   1. Literature and Drawings describing the equipment in sufficient details, including parts list and materials and details of construction, to indicate full compliance with the detail Specifications.
   2. Certified dimensional Drawings of each item of equipment and auxiliary apparatus to be furnished.
   3. Certified foundation and anchor bolt plans and details.
   4. Schematic electrical wiring diagram and other data as required for completion of installation.
   5. The total weight of the equipment including the weight of the single largest item.
   6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc., on the list. List bearings by the bearing manufacturer's numbers only.
   7. Complete description of surface preparation and shop prime painting.
   8. Test results for factory prototype and production model tests.

1.07 OPERATING INSTRUCTIONS

A. Operating and maintenance instructions shall be furnished to the ENGINEER as provided for in Section 01600.

B. A factory representative who has complete knowledge of proper operation and maintenance of the equipment shall be provided for two days to instruct representatives of the OWNER and the ENGINEER on proper operation and maintenance. This work shall not be conducted until the inspection of installation and test run as provided under Paragraph 3.05 of these Specifications are complete.

1.08 TOOLS AND SPARE PARTS

A. The required spare parts for the generator shall be those as recommended by the manufacturer and shall include the following items as a minimum:
   1. All special tools required for normal operation and maintenance.
   2. One air cleaner element.
   3. One oil filter.
   4. One set of fan belts.

B. All spare parts shall be packed in containers which are clearly identified with indelible markings on containers.

1.09 WARRANTY

A. Equipment furnished under this section shall be guaranteed against defective parts or workmanship under terms of the manufacturer's and dealer's standard warranty, but in no case less than two (2) years from date of initial startup of the system and shall include labor and travel time for repairs at the job site for the entire warranty period. Prorating of any item is not acceptable. All equipment furnished must be supported 100% by the generator set supplier. Units with the engine or generator warranty from a manufacturer other than the manufacturer of the generator set are not acceptable.

PART 2–PRODUCTS

2.01 GENERATOR

A. The generator shall have the following ratings (at 1,800 rpm):

Standby KW with fan	2000 KW
Standby KVA with fan	2500 KVA
Voltage	4160V, 3 Phase, 3 wire, 60 Hz
Engine Rating Conditions	29.61 HG and 77°F
Power Factor	0.8
Frequency	60 Hz
Maximum Ambient Temperature	124°F
Minimum Ambient Temperature	-20°F

B. The specified standby KW shall be for continuous electrical service during interruption of the normal utility source.

C. The Ratings must be substantiated by manufacturer's standard published curves. Special ratings, maximum ratings, or ratings guaranteed within 5% are not acceptable. The specified rating is the net KW available after deducting all engine driven accessories.

D. The generator shall be a 3 phase, 60 Hz, single bearing, synchronous type with brushless exciter and be built to NEMA Standards. Class H insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and/or abrasion deterioration. Generator shall incorporate reactive droop compensation for parallel operation and shall also include fuses for exciter/regulator protection against extended low power factor loads and faults. The generator rotor shall be layer wound, tested for 150% overspeed at 170° ambient and dynamically balanced to ½ mil. A 120 volt anti-condensation heater shall also be provided.

E. A generator mounted volts per hertz type regulator with 3 phase voltage sensing shall be provided to match the characteristics of the generator engine. Voltage regulation shall be ±½% from no load to full rated load. Readily accessible voltage droop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of ±10%.

F. A permanent magnet pilot excitation system shall provide power to the voltage regulator to improve the generator motor starting ability and short circuit support. It will also isolate the voltage regulator power circuit from voltage distortions created when the generator supplies a non-linear load.

G. The generator shall be provided with a cable bus termination box with bus bars for cabling to the power system utilizing the shielded cables.

2.02 ENGINE

A. The engine shall be water cooled in line, 4 stroke cycle compression ignition diesel with a minimum piston displacement of 4210 cubic inches. It shall meet specifications when operating on No. 2 domestic burner oil (ASIM D396). Diesel engines requiring premium fuels will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil coolers, fuel transfer pump, and gear driven water pump.

B. The engine governor shall be a Woodward 2301 electronic type and maintain isochronous frequency regulation from no load to full rated load. Steady state operating band shall be ±0.25%.

C. The unit shall be mounted on a structural steel base and shall be provided with suitable vibration isolators between the base and concrete slab.

D. Safety shutoffs for high water temperature, low oil pressure, overspeed, and engine overcrank shall be provided.

E. Lube oil shall be furnished by the generator set supplier.

2.03 COOLING SYSTEM

A. An engine-mounted radiator with a blower-type fan shall be sized to maintain safe operation at 124° maximum ambient temperature. The radiator shall be equipped for a duct adapter flange. Air flow restriction from the radiator shall not exceed 0.5 in H_2O. The CONTRACTOR shall provide duct work with flexible connecting sections between the radiator duct flange and exhaust damper.

B. The engine cooling system shall be filled with a solution of 50% ethylene glycol.

C. Provide a radiator mounted fuel cooler sized to remove 500 BTU/min with a flow of 4.5 GPM in less than 8.7 PSI maximum total restriction.

2.04 FUEL SYSTEM

A. A 6,000 gallon fuel storage tank is provided for diesel storage.

B. The generator shall be provided with a day tank and 120 VAC bronze gear pump with stainless steel shaft and a 50-gallon day tank. Fuel piping shall be provided with a water separator.

C. Engine mounted fuel filter, fuel pressure gauge, fuel priming pump, and flexible fuel connections shall be provided at engine.

2.05 EXHAUST SYSTEM

A. Provide a side inlet residential type silencer, including stainless steel flexible exhaust element. The silencer shall be mounted so that its weight is not supported by the engine.

2.06 AUTOMATIC STARTING SYSTEM

A. 24 volt DC electric starting system with positive engagement drive shall be furnished.

B. Fully automatic generator set start/stop controls in the generator control panel shall be provided. Control shall provide shut down for oil pressure, high water temperature, overspeed, overcrank and one auxiliary contract for activating accessories. Control shall include cycle crank with adjustable 1 - 60 second crank/rest period.

C. A 24 volt lead acid storage battery set of the heavy duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for 1½ minutes total cranking type without recharging and will be rated no less than 190 amp hours. A battery rack and necessary cables and clamps shall be provided.

D. A current limiting 2 rate battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicone diode wave rectifiers, voltage surge suppressors, DC ammeter, DC voltmeter, low DC voltage alarm relay, and fused AC input. AC input voltages shall be 120 volt single phase. Amperage output shall be no less than 10 amperes. The charger shall be mounted inside the diesel generator enclosure. Charger mounted inside the automatic transfer switch enclosure are not acceptable.

E. A unit mounted thermal circulation type water heater, incorporating a thermostatic switch, shall be furnished to maintain engine jacket water to 90°F in an ambient temperature of 30°F. Each heater shall be 240 volt, single phase, 6 KW, 60 Hz. Valves shall be installed in the inlet and outlet lines at the block to allow replacement of the lines and heater element without draining the cooling system.

2.07 GENERATOR CONTROL PANEL

A. A generator mounted NEMA 1 type vibration isolated dead front, 14 gauge steel panel, designed and built by the system manufacturer in accordance with NFPA 110, shall be provided.

B. Equipment -The panel shall contain, but not be limited to, the following equipment:
   1. Digital display or analog meters for:
      a. Voltmeter, 1% accuracy
      b. Ammeter, 1% accuracy
      c. Frequency meter, 1% accuracy
   2. Ammeter/voltmeter selector switch
   3. Automatic starting controls as specified above
   4. Engine control switch for auto start/manual start, off/reset, and stop
   5. Safety shutdown protection with LED indicators or alarm lights for:
      a. Low oil pressure
      b. High coolant temperature
      c. Low coolant level
      d. Overcrank
      e. Overspeed
   6. Digital display or gauges for:
      a. Coolant temperature
      b. Oil pressure
      c. Service hours
      d. Tachometer - engine rpm
      e. System DC volts
   7. Cool-down timer, adjustable 1 to 30 minutes. Factory set for five minutes.
   8. Emergency stop push button with LED indicator or alarm light.
   9. Voltage adjust rheostat.
   10. Panel lights and on/off switch.
   11. Digital displays for meters must be accurate through a temperature range of -40°F to 158°F and distorted wave forms and SCR load applications shall not affect instrument accuracy.

C. Generator mounted control panel pre-alarm module in accordance with NFPA 99 and includes alarm horn, silence button and LED annunciation or alarm lights for:
   1. High water temperature.
   2. Low coolant temperature.
   3. Low oil temperature.
   4. Low battery voltage.
   5. Battery charger malfunction.
   6. Low fuel level-main tank.
   7. System not in auto-start stop mode.
   8. Two spare LED's or alarm lights for user.

D. The generator control panel shall provide a separate dry contact output indicating generator run for telemetry monitoring.

E. One 8 light annunciator panel shall be provided for remote mounting to give audible and visual warning of fault or alarm conditions in the generator set. The panel shall conform with the requirements of the National Electrical Code, and the National Fire Protection Association publication, NFPA110. All necessary contactors shall be provided including low fuel level in the storage tank for fault conditions as follows:
   1. Low oil pressure-red.
   2. Low coolant temperature-amber.
   3. Low fuel in main tank-amber.
   4. Overspeed-red.
   5. High coolant temperature-red.
   6. Overcrank-red.

7. Battery charger malfunction-red.
8. Generating-amber.
9. Silence/acknowledge.

2.08 AUTOMATIC TRANSFER SWITCH

A. One automatic transfer switch shall be furnished, as shown on Drawings and tabulated in Paragraph U, this section. Switch shall be capable of switching all classes of loads and shall be rated for continuous duty, when installed in a non-ventilated enclosure. A NEMA 1 free-standing enclosure shall be constructed of 12 gauge steel and conformed to UL 50 standards. The enclosure shall have front and rear access.

B. The transfer switch shall be top and bottom accessible.

C. The main contacts shall be permanently sealed, maintenance-free, and shall be capable of being replaced without removing the main power cables.

D. The 5KV main contacts shall be sealed in an epoxy resin case that is sealed for life.

E. All active contactor parts shall be maintenance free.

F. All bolted bus connections shall have Belleville compression type washers.

G. When a solid neutral is required, a fully rated bus bar with required neutral lugs shall be provided.

H. Control components and wiring shall be front accessible. All low voltage control wires shall be multiconductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.

I. The switch shall be equipped with 90 degrees C rated NEMA type; 2 hole long barrel compression lugs.

J. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

K. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism. Minimum transfer time shall be 400 milliseconds.

L. The normal and emergency contacts shall be positively interlocked to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions.

M. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with NiCad battery back-up.

N. The CPU shall be equipped with self-diagnostics, which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit.

O. The controller shall use industry standard open architecture communication protocol for high-speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4,000 feet of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.

P. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.

Q. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.

R. The controller shall be capable of storing the following records in memory for access either locally or remotely:
1. Number of hours transfer switch is in the emergency position (total since record reset).
2. Number of hours emergency power is available (total since record reset).
3. Total transfer in either direction (total since record reset).
4. Date, time, and description of the last four source failures.
5. Date of the last exercise period.
6. Date of record reset.

S. Sequence of Operation:
1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

T. Automatic Transfer Switch Accessories
1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20% and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation.) Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.

5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position, controller is running, and fail to transfer alarm.
13. A plant exerciser shall be provided with (10) 7-day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one-minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad imitated.
14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reached 90% of its rated values (switch will remain in normal). In the "commit position," the load will transfer to the emergency position after any normal power failure. Keypad initiated.
15. Two auxiliary contacts rated 10 Amp, 120 volts AC, shall be provided, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for the normal or emergency source.
17. A digital LCD frequency readout with 1% accuracy shall display frequency for the normal or emergency source.
18. An LCD readout shall display normal source and emergency source availability.

U. The Transfer switch shall be as follows:
1. 400 amp (100% rated)
2. 4160 volts
3. 3 phase
4. 60 Hz
5. 3 pole

V. The transfer switch shall provide a separate dry contact output to indicate emergency power selected for telemetry monitoring.

W. The automatic transfer switch shall be a Russelectric RMTD type, or equal.

2.09 ANNUNCIATOR PANEL

A. A panel shall be provided for remote mounting to give audible and visual warning of fault or alarm conditions in the generator set. The panel shall conform with the requirements of the National Electrical Code, and the National Fire Protection Association publication, NFPA No. 99A. All necessary CONTRACTORS shall be provided including low fuel level in the storage tank for fault conditions as follows:
   1. Low oil pressure
   2. Low water temperature
   3. Low fuel in main tank
   4. Overspeed
   5. High water temperature
   6. Overcrank
   7. Battery charger malfunction
   8. Generating
   9. Silence/acknowledge switch
   10. Alarm horn

2.10 EMERGENCY SHUTDOWN SWITCH

A. Provide a surface mounted emergency shutdown switch with a red mushroom head for mounting outside the entrance door into the generator room. The device shall include two contactors and be wired to shutdown the engine and provide a remote alarm signal. The switch shall be mechanically latched when activated. In addition, a normal open 24 volt DC solenoid valve is to be provided that will shut off the fuel line to the engine at the same time the engine is shut down electronically.

PART 3–EXECUTION

3.01 DELIVERY AND STORAGE

A. All equipment shall be crated and delivered to protect against damage during shipment.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the ENGINEER.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the location shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts (304 SS) shall be set by the CONTRACTOR in accordance with the manufacturer's recommendations.

3.03 SHOP PAINTING

A. Field painting is specified under Section 09900. Where field painting will be required, shop primer and shop paint system shall be compatible with the field system to be used. It is the

CONTRACTORS responsibility to coordinate between equipment painting and field painting subcontractor.

3.05 INSPECTION AND TESTING

A. After equipment has been completely installed, conduct in the presence of the ENGINEER, such tests as are necessary to indicate that performance conforms to the Specifications. Testing shall be in accordance with Paragraph 1.05.

B. If the performance does not meet the Specifications, corrective measures shall be taken or equipment shall be removed and replaced with equipment which satisfies the conditions specified at no additional expense to the OWNER.

3.06 SCHEDULED OIL SAMPLING

A. In order to minimize engine downtime, the supplier of the emergency generator must provide an oil sampling analysis kit which operating personnel shall utilize for scheduled oil sampling.

B. Scheduled oil sampling shall be of the atomic absorption spectrophotometry method and shall be accurate within a fraction of one part per million for the following elements: iron, chromium, copper, aluminum, silicon, lead. In addition, the sample shall be tested for the presence of water, fuel dilution and antifreeze.

C. All equipment needed to take oil samples shall be provided in a kit at the time of acceptance and shall include the following:
1. Sample Extraction Gun (1)
2. Bottles (10)
3. Postage Paid Mailers (10)
4. Written Instructions (1)

D. Immediate notification shall be provided to the OWNER when analysis shows any critical reading. If readings are normal, a report showing that the equipment is operating within established parameters shall be provided.

E. The scheduled oil sampling kit shall be made available at additional cost to the OWNER beyond the mandatory starter kit specified previously and shall be optional for the OWNER to continue this service after the starter kit has been depleted.

END OF SECTION

SECTION 16930

INSTRUMENT WIRE AND CABLE

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 QUALITY ASSURANCE

A. Standards: Comply with standards specified in this Section as listed in Division 1.

B. Qualifications of Installers: Use skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.03 PRODUCT HANDLING

A. Instrument cable shall be furnished in lengths as necessary.

B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01300–Submittals.

PART 2–PRODUCTS

2.01 GENERAL

A. All materials of construction for cable and wire shall be compatible and noncontaminating.

B. Unless otherwise noted in these specifications, the requirements herein listed shall be strictly adhered to.

2.02 ELECTRONIC INSTRUMENT WIRING, PAIRS 4-20 mA–D.C. PROCESS INSTRUMENTATION

A. Pairs (2/C) shall have stranded, tinned copper conductors, No. 16 AWG, twisted with 2-inch lay.

B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.

C. Color coding shall be manufacturer's standard or as stated.

D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils-thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power limited circuit cable.

E. If the electronic instrument wire is not installed in steel conduits, a 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A No. 18 AWG, 7 strand, tinned copper drain wire shall be furnished in continuous electrical contact with the shield.

F. Single pair, shielded cables shall be Belden 9316, or equal.

2.03 ELECTRONIC WIRING–MULTICONDUCTOR CABLES–4-20 MA–D.C. PROCESS INSTRUMENTATION

A. All multiconductor cables for D.C. process instrumentation signals shall be in accordance with this section unless there are unusual requirements by the instrument vendor.

B. Multiconductor cables shall have No. 20 AWG, stranded tinned copper conductors, arranged in pairs or triples, twisted with 1 1/2 inches to 2 1/2 inches staggered lay.

C. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties. Pairs or triples shall be numbered consecutively.

D. Color coding shall be manufacturer's standard or as stated.

E. An overall 100% coverage shield consisting of 2.35 mil aluminum mylar tape shall cover the conductors with a No. 20 AWG, 7 strand, tinned copper drain wire in continuous electrical contact with the shield.

F. The outer jacket shall be flame-retardant and ultraviolet-resistant PVC, 50 mils minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cable.

G. For flow meters or other signals requiring low cross-talk characteristics, each pair or triple shall have a separate, insulated, 100% coverage shield consisting of an 0.85 mil minimum thickness aluminum mylar tape with No. 22 AWG, 7 strand, tinned copper drain wire in continuous electrical contact with the shield.

2.04 THERMOCOUPLE LEAD EXTENSION WIRE–SINGLE PAIR

A. All wiring for individual thermocouple signals shall conform to the specifications in this section unless otherwise noted.

B. The paired conductors for individual thermocouple lead wire shall be of the same material as the thermocouple element, unless otherwise noted. Unless otherwise specified, standard calibration in accordance with ISA RP1.1-3 shall be furnished.

C. Gauge size of the thermocouple lead wire conductors shall be determined by the requirements of the receiving end equipment but not smaller than No. 16 AWG. The insulated conductor shall be twisted with a 2-inch lay unless otherwise noted.

D. Insulation and jacket material for the lead wire shall be as follows:

Ambient Temperature	Insulation	Jacket
-30°F to +175°F (-340°C to 79°C)	105° PVC	80° Minimum PVC
175°F to 400°F (79°C to 204°C)	FEP	FEP
400°F to 750°F (204°C to 399°C)	Glass Braid	Glass Braid
400°F to 1800°F (204°C to 982°C)	Ceramic Braid	Ceramic Braid

(or where protection is necessary)

E. Insulation of conductors for 175°F (79°C) maximum service shall be 15 mils PVS 105°C minimum, rated for 300 volts. The insulation shall conform to ANSI color code requirements.
1. A 100% coverage shield consisting of an 0.85 mil minimum thickness aluminum mylar tape shall cover the conductors with a No. 18 AWG, 7 strand or solid tinned copper drain wire in continuous electrical contact with the shield.
2. The outer jacket shall be ANSI color-coded, flame-retardant and weather- and sunlight-resistant PVC, 35 mils minimum thickness and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited tray cable.

F. Insulation of conductors for 400°F (204°C) maximum service shall be 12 mil FEP 200°C minimum, rated for 300 volts minimum. The insulation shall conform to ANSI color code requirements.
1. A 2 mil NOMEX fire-resistant tape shall cover the conductors.
2. A 100% coverage shield consisting of a 2.35 mil minimum thickness aluminum-NOMEX tape shall cover the fire-resistant tape with a No. 18 AWG, 19 strand, tinned copper drain wire in continuous contact with the sheath. The NOMEX shield shall be color-coded to ANSI standards.
3. The outer jacket shall be flame-retardant, weather- and chemical-resistant FEP 12 mil minimum thickness and 200°C minimum rating.

G. The conductors for 750°F (399°C) maximum service shall be solid with a parallel lay. The insulation shall be 5 mil glass yarn, 399°C minimum, impregnated with a high temperature saturant. The insulation shall conform to ANSI color code requirements and be rated for thermocouple use only. The outer jacket shall be 5 mil braided glass yarn, 399°C minimum, impregnated with a high temperature saturant. These conductors shall be used only abovegrade in steel conduits.

H. The conductors for 1800°F (982°C) maximum service shall be solid with a parallel lay. The insulation shall be color-coded with colored threads under the conductors and be rated for thermocouple use only. The outer jacket shall be braided ceramic yarn, 1093°C minimum. These conductors shall be used only abovegrade in steel conduits.

2.05 THERMOCOUPLE LEAD EXTENSION WIRE–MULTIPAIR

A. The paired conductors for the thermocouple circuits within the cable shall be the same material as the thermocouple elements, unless otherwise noted. Unless otherwise specified, standard calibration in accordance with ISA RP1.1-3 shall be furnished. The insulated conductors shall be twisted with 1 1/2 inches to 2 1/2 inches staggered lay. Minimum gauge size shall be No. 20 AWG.

B. The insulation of conductors shall be 15 mils PVC 105°C minimum, rated for 300 volts. The insulation shall conform to the color-code requirements. Pairs shall be numbered consecutively.

C. Each pair shall be provided with an insulated, 100% coverage aluminum mylar tape shield over each individual pair. The shield shall consist of an .85 mil minimum thickness aluminum mylar tape with a No. 22 AWG, 7 strand or solid tinned copper drain wire in continuous electrical contact with the shield.

D. A 100% coverage shield consisting of 2.35 mil minimum thickness aluminum mylar tape shall cover the conductors with a No. 20 AWG, 7 strand, tinned copper drain wire in continuous electrical contact with the shield.

E. The outer jacket shall be ANSI color-coded, flame-retardant, and weather- and ultraviolet-resistant PVC, 40 mil minimum thickness, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited tray cable.

2.06 SPECIAL CONSIDERATIONS

A. Although twisted conductors effectively reduce magnetic noise, where additional magnetic shield is necessary to minimize interference from stray magnetic fields, armored electronic instrumentation and thermocouple lead extension wire shall be provided.

B. Since magnetic interference is produced by currents flowing through conductors and electrical equipment, any instrument wire run near electric motors, generators, transformers, induction heaters, circuit breakers, motor starters, power lines, or AC power and control cables may need additional magnetic shielding.

C. Armor may be necessary on instrument cables installed in ladder-type trays or in nonmagnetic electrical ducts.
   1. Electronic instrument wiring, pairs and triplets, and thermocouple lead extension wire, single pair. There shall be a steel wire armor of 24 gauge AISI 1006 soft annealed steel wire covering the inner jacket.
   2. Electronic instrument wiring, multiconductor cables, and thermocouple lead extension wire, multipair. There shall be a flexible interlocked galvanized steel armor covering the inner jacket.
   3. The armor shall be covered by a flame-retardant and weather- and ultraviolet-resistant PVC, outer jacket 35 mil minimum thickness and 80°C minimum rating. The outer

jacket shall contain a ripcord and shall equal or exceed the physical characteristics of UL 1277. Cable shall be UL labeled as power limited cables.

D. Individual lead wires and/or multipair cables used in "emergency" or "critical" service shall normally be installed in underground electrical duct banks.

E. Where circumstances prohibit underground installation of "emergency" or "critical" circuits, the lead wires and/or multipair cables shall conform to the appropriate sections of this specification, except they shall be armored and have an asbestos layer between the inner jacket and the armor to permit the wires to withstand an open-flame temperature of 1700°F for a minimum of 20 minutes without interrupting the "critical" or "emergency" signals.

PART 3–EXECUTION

3.01 GROUNDING

A. All shields must be grounded.

B. Shields shall be grounded at one point only. Single-pair electronic instrument cable shields shall be isolated and left open at the instrument. The single-pair electronic instrument cable shields shall be connected to the multipair electronic instrument cable overall shield in the field junction box. The multipair electronic cable overall shield shall be grounded to the control room instrument.

C. Single pair thermocouple cable shields shall be connected to the individual pair shields of multipair thermocouple cables in the field junction boxes to maintain shield continuity for each individual shielded pair from the thermocouple to the input component in the control room. The multipair thermocouple cable overall shield shall be isolated and left open in the field junction box. The individual thermocouple pair shields shall be grounded at the thermocouple connection head. The multipair thermocouple cable overall shield shall be grounded at the control room instrument ground. The other ends of the individual thermocouple pair shields and the multipair thermocouple cable overall shield shall be isolated and left open.

D. When multipair electronic instrument cable is specified with individual shielded pairs to minimize cross talk on flow meters or other pulsating signal applications, the shielding and grounding of the individual pair shields and the multipair overall shield shall be the same as for thermocouple applications.

E. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.

F. The control room instrument ground shall be separate and isolated from the electrical power grounding system.

END OF SECTION

SECTION 16940

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

A. Work Included: Furnishing, installing, and placing into operation a control and instrumentation system to control and monitor booster pumps, pump control valves, tank level, discharge pressure, station flow, and other features specified herein.

B. Related Sections and Divisions: Applicable provisions of Division 1 shall govern work in this section.

1.02 SYSTEM DESCRIPTION

A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the Supervisory Control and Data Acquisition System (SCADA) for the Franklin County Booster Pump Station.

B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets and required interface hardware and internal wiring, the SCADA System

computers, hardware, system drawings, and system software. See paragraph 1.09 for other System Supplier requirements.

C. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.

D. CONTRACTOR shall be responsible for the placing of circuits and making of electrical and hydraulic connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to ensure proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; to adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in a manner fully satisfactory to ENGINEER. This will include on-site review of software/hardware controls from the central control point.

E. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier. All switches and control and indicating lights associated with the control panels shall be new and installed in the starter panels.

1.03 QUALITY ASSURANCE

A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA Systems of the size and complexity specified herein and whose systems have been in satisfactory use in similar service for not less than 10 years.

B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.

C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, connectors, etc., that have been listed and labeled by Underwriters' Laboratories.

E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.

B. Submit shop drawings and product data in accordance with provisions of Section 01300-Submittals.

C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.

D. Shop drawing submittals shall include the following information in booklet form:
   1. Detailed catalog information, descriptive literature, and specifications of hardware. **All items being provided must be specifically noted on this literature.**
   2. All field devices and instruments.
   3. A complete set of system P & IDs.
   4. Wiring diagrams for all supervisory control centers and motor control centers.
   5. SCADA I/O Listing.
   6. Control narratives.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01300-Submittals.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

C. Submit Operation and Maintenance Manuals in accordance with Division 1. The following additional information shall apply:
   1. Manuals shall contain, but not be limited to, the following:
      a. System Hardware.
      b. System Software.
   2. Hardware section to include:
      a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
      b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.

1.06 DELIVERY, STORAGE, AND HOLDING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to supervisory control center components, enclosure, and finish.

1.07 DESCRIPTION OF THE BOOSTER PUMP STATION CONTROL SYSTEM

A. The pump station SCADA monitoring and control system consists of the following major items:
   1. Bristol "Control Wave" telemetry system to communicate with OWNER's existing Bristol telemetry system. CONTRACTOR shall provide a hardware for a complete operating system. OWNER will perform programming for the new units and modify the existing system as required.
   2. Pump station flow is monitored by a Venturi flow meter.
   3. Tank level is monitored by a pressure transducer.
   4. Discharge pressure is monitored by a pressure transducer.

1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

A. This specification, along with the Contract Drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a

process monitoring and control system specifically for the demanding requirements of a real-time process management and control system.

B. It is the intent of this specification to define a fully integrated open-type process monitoring and control system, factory tested, delivered to the site ready to function upon connection of power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other Divisions of these specifications and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER in writing any deficiencies noted during this review. Any changes required by CONTRACTOR due to failure to complete this review shall be the responsibility of CONTRACTOR at no increase in cost to OWNER.

C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals and contacts that are compatible with the systems as specified herein. CONTRACTOR shall also be responsible for complete coordination with manufacturers of other systems specified in other divisions of these specifications with which an interface is required. The Contract Drawings and I/O listing are symbolic representatives of the required work. It is not intended that the Drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the Drawings, specifications, and standard industry practices.

D. To ensure a complete and totally integrated system, a single manufacturer who has experience in furnishing similar control systems of the same complexity and size for municipal water distribution facilities, shall provide specified equipment and services. The system proposed to meet this specification shall be of field proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.

E. Design and specification of devices and completed system shall conform to applicable portions of latest edition of National Electrical Code (NEC).

F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled but do not have UL approval as an assembled unit are not acceptable.

G. Training Program:
   1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule.
   2. Provide materials, instructors, and workbooks to complete the training.
   3. Training courses shall include:
      a. Operator training. Course length minimum four hours. Training shall utilize equipment specified herein following installation and field testing. (One four-hour session with four operators each shall be provided at the pump station.
   4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.

H. System Supplier shall meet the following minimum requirements:
   1. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.

2. System Supplier shall have an adequate inventory of spare parts.
3. System Supplier shall have a full-time staff of qualified service technicians.
4. System Supplier shall be responsible for the documentation of the system.
5. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
6. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, etc., and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.

I. All components are to be standard make acceptable to OWNER, with one manufacturer to provide all similar components.

1.09 EQUIPMENT ENCLOSURES

A. New enclosures shall be front access only, minimum No. 12 gauge steel, and hinged doors, rotating lockable handle latch on each supervisory equipment compartment door (not screws or bolts) with top and bottom bolts actuated by one rotating handle on large doors. Provide door stop kit for all panel doors, data pockets for wiring diagrams, and minimum 18-inch fluorescent light and switch. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust inhibiting enamel, white interior, and OWNER-selected exterior color. All doors and panels shall be gasketed. All louvers shall be filtered with forced air cooling as necessary by the supplier for conditions where installed. New enclosures shall be a minimum of 20 inches wide, 20 inches deep, and 90 inches high.

B. Indication gauges shall be at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of gauge.

C. Plastic wiring troughs shall have removable covers. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 2 inches between terminal strip and wiring trough.

D. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections on the sides. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. All wiring shall be labeled at each end with corresponding numbers. This numbering shall be shown on the shop and record Drawings.

E. All devices shall be furnished flush-mounted, and an exterior engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each compartment, device, light, etc. All components within the cabinets shall be identified with interior mounted engraved labels. Devices shall be grouped for each device or unit being controlled.

F. All panels with DIN rail mounted equipment shall include a minimum of 25% spare DIN rail space.

G. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals, wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g. 120V, 24V).

H. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

1.10 COMMON REQUIREMENTS ALL EQUIPMENT

A. All indicating and recording devices shall be electric or electronic.

B. All motor control power shall be 120 volt with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.

C. Devices powered at 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to, solenoid valves, motor-operated valves, motorized ball valves, flowmeters, scales, transducers, etc.

D. Provide lightning protection, isolation transformers and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120 volt power shall be available at all control points. Lightning protection shall be completely solidstate, self-healing, and not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 20 ampere, 120 volt receptacle.

E. If enclosure and panel space is needed for future installation of devices, lights, etc., the enclosure and panel shall be constructed for such installation. Supports shall be provided for future equipment, and panel openings shall be made and covered with neat cover plates matching the panel.

F. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided even though the detailed enumeration at various control points may omit listing that equipment.

G. Where a certain accuracy of sensing and transmitting levels or flows and controlling operations are called for, means must be provided to read or determine that the levels or flows are within the limits or accuracy specified of the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of levels is necessary to set operating points, an indicating device of accuracy consistent with the operation of the system is required.

H. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.

1.11 GENERAL CONTROL ALGORITHMS

A. In general, the following is a definition of I/O at each MCC:
   1. Run from MCC or auxiliary starter contact (dry contact).
   2. Fail from MCC or starter auxiliary O.L. contact (dry contact).
   3. Command Run Maintained start or as required (dry contact).
   4. Hand-Auto from MCC or Controller Selector Switch (dry contact), feedback to SCADA.
   5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.

B. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate the SCADA to the alarm state.

C. Provide "Out of Service" indication for each piece of equipment when that equipment's MCC or SCADA HOA is not in the Auto position.

PART 2–PRODUCTS

2.01 PANELS

A. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for three years from start-up.

B. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.
   1. All wiring within the enclosure shall be through the plastic wiring ducts. All wiring not in ducts shall be in plastic spiral bindings. All I/O devices shall be wired to rail mounted terminal blocks.
   2. All field wiring shall terminate at the rail mounted terminal blocks that shall be mounted either at the bottom or at the top of the enclosure back panel depending on where the I/O conduits penetrate the enclosure.
   3. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired.
   4. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer.

C. The color code for panel and field wiring shall be as follows:
   1. Discrete 120 VAC Input:
      a. Hot Wire: Red
      b. Neutral Wire: White
      c. Switched Wire: Brown
   2. Discrete 120 VAC Output:
      a. Hot Wire: Red
      b. Switched Wire: Blue
   3. 120 VAC Panel Power:
      a. Hot Wire: Red
      b. Neutral Wire: White
      c. Ground Wire: Green

D. 24 VDC power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.

E. Current-to-current isolators shall be provided and installed in remote mounted enclosures for isolating all existing analog input signals. NEMA rating of enclosures shall be as required for the area where installed.

F. Manufacturer of Accessories:
   1. The plastic wiring duct shall be Electrovert "Electro-Duct," Panduit, or equal.
   2. Terminal blocks shall be Phoenix Contact UK 5 N, or equal.
   3. Wire markers shall be Electrovert Z Type PVC Markers, Partex, or equal.
   4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be of the rail mounted-type such as Square D, Class 9080, Type GCB-150, or equal.
   5. Power supplies shall be Sola, rail mount, SPD or SDN Series, or equal.

6. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.

2.02 RADIO TELEMETRY SYSTEM

A. Provide one remote radio telemetry unit at the booster station and all appropriate accessories for a complete, operational, radio telemetry system. Furnish one additional remote radio to OWNER for use as a spare.

B. System Supplier shall perform radio path study and design communication system for 99.9% reliability and provide all radio frequency coordination and FCC licensing procedures.

C. Master Station and Remote Radios:
   1. The units shall operate on the existing OWNER's frequency (453.63750 MHz).
   2. The unit chassis shall be cast aluminum to eliminate interference with data/controller equipment. Plastic housings are not acceptable. All PC boards, including modem and diagnostic boards, shall be enclosed in the chassis.
   3. The radios shall be suitable for 120/240 VAC input with battery backup. Individual LED status indicators shall be located on the front of the unit.
   4. Antenna connection shall be Type N, female.
   5. Temperature range for full performance shall be -30°C to 60°C with operational performance from -40° to 70°C. Humidity range for full performance shall be 0 to 95% relative humidity, noncondensing.
   6. The remote unit must be fully synthesized and programmable to all frequencies via a personal computer or hand-held terminal without changing internal components. Opening the radio to change modules, frequency crystals, or DIP switches is unacceptable.
   7. The master and remote station radios shall be MDS 4710 series as manufactured by Microwave Data Systems, or equal.

D. The radio telemetry system manufacturer shall provide the radio antennas for each site in the system. Instructions for installing and grounding these antennas shall be given to CONTRACTOR to ensure a reliable system. Unless specifically stated, the antennas shall be attached to existing structures. Particular importance shall be given to the correct installation of the antennas to give adequate lightning protection to the system. Each remote and the master station shall be tested to verify that reflected power is 5% of forward power or less.

E. Antennas shall be directional or omnidirectional as described below. They shall be of aluminum construction and rated to withstand at least 100 mph winds. Adequate lengths of transmission cable shall be provided for connection between the antenna and radio transceiver at each location.
   1. Antenna for the master station, or as required for the system configuration, shall be omnidirectional and shall meet the following specifications:
      a. Type: Dual conversion, superheterodyne
      b. Frequency Range: 390 to 470 MHz
      c. Gain: 9 dB
      d. Maximum Power Input: 500 Watts
      e. VSWR: Less than 1.5
      f. Lightning Protection: Direct ground protection to tower with Citel Model P8AX, or equal, surge protection device

g. Connector: 18-inch flexible extension (RG-393/U), Type N male with neoprene housing
h. Mounting Hardware: As recommended by manufacturer
i. Acceptable Manufacturers: Telewave, Scala, Sinclair, or equal

2. Antennas for each remote site, or as required for the system configuration, shall be directional (YAGI) type with the following characteristics:
a. Type: Dual conversion, superheterodyne
b. Frequency Range: 390 to 470 MHz
c. Gain: 10 dB, minimum
d. Maximum Power Input: 150 Watts
e. Lightning Protection: Direct ground protection to mast with Citel Model P8AX, or equal, surge protection device
f. Front-to-Back Ratio: 20 dB, minimum
g. Connector: Type N, female
h. Mounting Hardware: As recommended by manufacturer
i. Acceptable Manufacturers: Telewave, Scala, Sinclair, or equal

F. All antennas shall be grounded per the antenna manufacturers recommendations.

G. Transmission cable for all antennas shall be low-loss foam dielectric-type, 0.5-inch-diameter helix cable.
1. Provide a 6-foot section (3-foot for master radio) of "super flexible" transmission cable with male Type N connectors at the radio antenna ports to the connector at the enclosure. This section shall pass through the enclosure. Provide standard Type N connectors for connection to a continuous cable extending from enclosure to antenna. Cable shall be weatherproof and suitable for direct environmental exposure. Connections shall have o-ring seals. Acceptable cable manufacturer is Andrew Corporation, or equal.
2. Provide a male-to-male Type N connector where the antenna cable leaves the enclosure in which the radio is mounted. Cable from radio to connector at enclosure shall be "super flexible" and from the enclosure to the antenna shall be low-loss foam as described above. Provide a coaxial lightning arrestor for the antenna cable.
3. Coaxial lines to antennas shall be installed in conduit. Where antenna cabling exits the conduit, drip loops shall be provided.

H. System Supplier shall supervise the installation of all radio systems by CONTRACTOR.

I. Telemetry unit shall utilize a control wave PLC/RTU controller as manufactured by Bristol. The controller shall utilize a high speed arm based controller and shall be used to control four booster pumps and monitor activities at the booster pump station.

J. The telemetry unit shall have I/O capacity as shown on the Drawings.

2.03 PRESSURE SWITCHES

A. Pressure switches where called for shall be Square D, Type GAW for pressures as applicable. Dual stage pressure switches, where required, shall be Square D, Type GKW, for pressures as applicable.

2.04 LIMIT SWITCHES

A. Limit switches (door switches and stroke counters) where called for on the Drawings shall be Square D, Class 9007, Type C, or equal. CONTRACTOR shall provide head and body style to fit application.

B. Limit switches for sensing the position of swing arm check valves shall be Allen Bradley Bulletin 802T, or equal. Switch shall include enclosure rated for the space installed, cat whisker sensor in length required for application, and mounting hardware for check valve swing arm and flexible cable to junction box.

2.05 SUMP PUMP CONTROL

A. The controls for each duplex and simplex sump pump shall be installed where shown on the Drawings by this division. See Division 15 for controls to be provided and for interface requirements.

2.06 PRESSURE TRANSDUCERS

A. Pressure transducers shall sense gauge or differential pressure and provide a 4-20 maDC signal proportional to the sensed pressure. The control system will provide 24VDC loop power. Increasing pressure shall result in increasing signal.

B. Transducers shall be suitable for use in ambient conditions of 0°F to +180°F and 0 to 100% relative humidity.

C. Accuracy (including linearity, hysteresis, and repeatability) shall be a minimum of ± 0.10% of span. Long-term drift shall be less the ±0.1% of the upper range limit over a 12-month period. The transducer output signal shall not change more than 0.0005% of span for a 1V change in the loop voltage. Ambient temperature affect shall be less than ±0.6 psi for a 10 to 300 psi transducer that experiences a 100°F change in ambient temperature within the normal operating range. Mounting position shall not affect transmitter performance. RFI effect shall be less than 0.1% of span for radio frequencies in the range of 27 to 1,000 MHz and field intensity of 30V/m.

D. Process connection shall be 316L stainless steel fitting size and type as required by CONTRACTOR. Sensor material shall be 316L stainless steel, with silicone fill fluid. Sensor shall be suitable for use with process liquid/gas temperature from -50°F to +250°F.

E. Calibrated range shall be determined by the CONTRACTOR based on process conditions. Calibrated range and process conditions used to determine range and span limits shall be included in submittal.

F. Pressure transducer housing shall be NEMA 4X, epoxy-coated aluminum with a minimum of one 1/2-inch NPT conduit connection. Housing shall provide separation between electronics and field connections.

G. Digital indicator with transducer configuration pushbuttons shall be provided in the transducer housing. Transducer configuration shall be performed using pushbuttons on the transducer. A Hart communicator or other electronic device **shall not** be required to configure the transducer.

H. Transducer shall be direct connected to process unless specified otherwise on the Drawings. Provide stainless steel bracket and mounting bolts for surface mounting of transducer if wall mounting is specified. Provide 2-valve manifold for pressure transducers and three valve manifold with test ports for differential pressure transducers.

I. Provide stainless steel information tag that indicates instrument number, service, and calibration range.

J. Pressure transducers shall be Foxboro Model IGP20, ABB, or equal.

2.07 SMOKE DETECTORS

A. The detectors shall be listed to UL standard 217 and shall be documented compatible with the control equipment to which they are connected. The detectors shall have the following functions:
   1. 90dBA Solidstate, Nonlatching, Horn
   2. Nominal 2.5% Sensitivity
   3. 5-to-1 Signal-to-Noise Ratio
   4. Pulsing LED Sensing Chamber
   5. Fully Insect Screened
   6. Functional Test Switch–Patented Three Position Test
   7. Horn Frequency 3100Hz (Nominal)
   8. Solidstate LED Condition Indicator
   9. Mounting Hardware Adapts to Standard Junction Boxes
   10. Dust Cover to Prevent Contamination During Installation
   11. 1-Year Warranty

B. The detectors shall have Integral Thermal heat sensing so that alarm activation shall occur due to smoke or heat detection. The integral thermal device shall be self-restoring and be rated for 135° at 50 feet. The detector shall have Form A/C contacts and be capable of having up to 6 devices in tandem on the same indication and power circuits.

C. The detectors shall operate at 120 VAC, 60 Hz. Device shall be rated for an operating temperature of 40°F to 100°F. The detectors shall be Gentex Model 7100TF, or equal.

2.08 SUBMERSIBLE DRAWDOWN TRANSDUCERS

A. Provide new submersible pressure transducers to measure well pump drawdown levels. The transducers shall be designed for direct submergence in all types of liquids and be as manufactured by Druck, Inc. Model PTX 1235, or equal.

B. All wetted metal parts shall be titanium.

C. The cable jacket shall be made of polyurethane and compatible with groundwater, surface water, including seawater, leachate, wastewater, and diesel oil.

D. The nose cone shall be made of either titanium or Acetal.

E. Submersible Pressure Transducer:
   1. Overpressure: 4 times minimum.
   2. Burst pressure: 6 times minimum to a maximum of 2000 psig.
   3. Media compatibility: Fluids compatible with titanium, polyurethane, and Acetal.
   4. Excitation voltage: 9 to 30 Vdc.

5. Output: 2-wire, 4-20mA.
6. Combined non-linearity, hysteresis, and repeatability: ±0.25% of Full Scale (FS).
7. Long term stability: ±0.2% FS per year.
8. Zero offset and span setting: ±0.5% FS.
9. Operating temperature range: -4 to 140°F.
10. Compensated temperature range: 30 to ±86°F.
11. Temperature effects: ±1.5% FS TEB (Thermal Error Band) for ranges 5 psi and up.
12. Pressure connection: Depth cone with radial inlet holes.
13. Electrical connection: Vented two conductor polyurethane cable with aluminum-mylar shield, kevlar strength member, and nylon vent tube, length as required.
14. Internally potted with molded cable.
15. Insulation resistance: better than 100 MegOhms at 500 Vdc.
16. Internal lightning arrestor compliant with IEC Level 4 Lightning Specification.
17. Voltage spike protection: withstand 600V voltage spike in accordance with ENV 50142 without damage when applied between all excitation lines and case.

F. Submersible pressure transducers shall have an integral cable that contains a vent tube that references the sensor to atmospheric pressure. The device shall have an internal lightning arrester that, with proper grounding, provides surge protection up to IEC Level 4. The molded polyurethane cable and internal potting in the transmitter shall prevent the ingress of water into the back of the transmitter. The vent tube shall be attached to the back of the sensing element, providing a gauge reference to atmosphere.

G. Pressure transducers shall include a terminal enclosure with desiccant to prevent moisture ingress via the vent tube or cable conductors. Enclosure shall dry the air which breathes into the tube via vent opening with a 35 micron PTFE filter that prevents water ingress even during flood conditions. Enclosure shall meet the following requirements:
1. NEMA 4X rated.
2. PVC base and clear Halogen-free self-extinguishing polycarbonate cover.
3. Equipped with screw terminals and DIN rail mounted terminal blocks.
4. Equipped with microfilter which prevents ingress of water.
5. Equipped with desiccant module with sight gage for determining desiccant change intervals.

2.09 PHASE FAILURE RELAYS

A. The pump station shall have a phase sequence and unbalance monitor installed. This relay shall be used to indicate power failure for the station.

B. Relay shall be Diversified Electronics, Inc., SLM-230 or 440–ASE. CONTRACTOR to select voltages.

2.10 ELECTRONIC INDICATORS

A. The electronic indicators shall be 3 and 4 digit LED-type. LED lights shall be a minimum of 0.75 inches. The instrument shall accept a 4-20 mA DC input signal. The meter accuracy shall be ±2% of full scale. Scales shall be as required.

2.11 ANNUNCIATOR

A. The annunciator shall be multiple point, solidstate unit of an integrated circuit design with individual point contacts. A separate display window and logic unit shall be provided for each point.

B. The display window unit shall be semiflush mounted on the cabinet front. Each point shall be back-lighted and be accessible from the front for ease of relamping.

C. The indication windows on the treatment plant annunciator shall be no smaller than 2 inches high by 2 inches wide nominal size. Windows shall have a white translucent background with 3/16-inch black engraved letters. A minimum of one spare blank window with control logic shall be provided for every four alarm points specified.

D. All points shall be plug-in type point logic modules containing solidstate electronics. Each module must be capable of operating from either normally open or normally closed trouble contacts.

E. Annunciator points shall be as listed on the Drawings.

F. The annunciators must be fully wired to accommodate all annunciator points.

G. The point modules shall be readily accessible by removal of a cover. Provisions for extending modules from the cabinet for testing purposes and visual checkout shall be provided. Sufficient extender boards shall be provided to fully test a point module.

H. Barrier-type terminal blocks shall be provided and shall be suitable for attaching up to No. 12 AWG stranded conductors for all field or OWNER connection points.

I. Provide 20 spare lamps with the system. All lamps shall be rated 25,000 hours.

J. The entire annunciator system shall be capable of a full functional test. The alarm horn shall tie into the annunciator, not backed up by battery power. Reset of the audible alarm will be accomplished by pressing the acknowledge button. Test and acknowledge pushbuttons shall be provided.

K. The operating sequence shall be as follows:

Alarm Contact	Lamp	Audible	Output Contact
Normal	Off	Off	Closed
Abnormal	Flashing	On**	Open
Acknowledge	On	Off	Closed
Return to normal*	On	Off	Closed

* The annunciator shall not return to normal until alarm has been acknowledged even though the alarm contact has returned to normal.

** All spare points shall have audible alarm optional.

L. One normally closed dry output contact shall be provided for each of the points. Solidstate outputs are not acceptable. All output contacts shall be wired to terminal blocks for

individual or grouped feeding of annunciator points for connection to remote equipment, i.e., alarm dialer.

M. Individual isolated alarm point contacts shall be arranged for field connection.

N. A 0- to 15-minute time delay shall be provided that will delay transmission of the alarms to the dialer allowing plant personnel at the site time to acknowledge alarm conditions.

O. The annunciator shall be as manufactured by Ronan Model 64X111000E3000 and shall be mounted in the Supervisory Control Center. The annunciator shall operate satisfactorily with a temperature range from 30° to 125°F.

2.12 TVSS DEVICES FOR CONTROL PANELS AND INSTRUMENTATION EQUIPMENT

A. The incoming power supply of each control panel shall be protected with a transient voltage surge suppression (TVSS) device. TVSS unit shall be as manufactured by Citel Model M18-120, or equal.

B. Each analog signal entering or leaving a supervisory control panel and leaving a building shall be provided with a DIN-rail mounted surge protection device as manufactured by Citel, Model DL-24, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel Model TSP-10, or equal, on the output and Citel Model M18-120, or equal, on the power supply.

2.13 INTRINSIC SAFETY BARRIERS

A. Instrumentation equipment located in hazardous areas as noted on the Drawings shall be wired to intrinsic safety barriers. Safety barriers for discrete devices shall include indicating LED and be DIN-rail mounted, as manufactured by Phoenix, Model PI-EX-ME-2NAM/COC, or equal. Safety barriers for analog devices shall be DIN-rail mounted, as manufactured by Phoenix, Model PI-EX-ME-RPS-I/I, or equal.

2.14 PHOTOCELLS

A. Photocell controller shall be rated 2000 watts tungsten at 120, 240, or 277 volts. The photocell shall be cadmium sulfide, 1-inch-diameter, gasketed for maximum weatherproofing.

B. Photo-cell mounting shall include a weatherproof wall plate with neoprene gasket suitable for attachment to an approved outdoor junction box.

C. Photocell controller shall include a delay of up to two minutes to prevent false switching. On-activation shall occur at 1-5 footcandles; off-deactivation shall occur at 3-15 footcandles.

D. Operational temperature range shall be -40°F to 140°F (-40°C to 60°C). All photocells shall be UL listed and include a 5-year warranty.

E. Photocell shall be Intermatic, or equal, K4000 Series with weatherproof wall plate, light shield, and neoprene gasket. Install where shown on the Drawings.

2.15 FLOW SWITCH

A. Flow switches shall be paddle type, comprised of 316 stainless steel housing and spring, and 302 stainless steel paddle, suitable for use in water service. Switch shall be mounted in process piping using 1-inch NPT fitting.

B. Switch shall be suitable for use in pressures up to 2,000 psig. Maximum pressure drop across switch shall be 3 psig.

C. Switch shall be rated for use in temperatures from -30°F to 300°F.

D. Switch shall provide SPDT contact for use with external control system. Contact shall be rated for 0.5A at 120VAC, minimum.

E. Flow switch shall be Gems Sensors, FS-550 Series.

2.16 ARC FLASH HAZARD WARNING LABELS FOR NEW EQUIPMENT

A. Equipment specified herein shall be provided with arc flash hazard warning labels based on an arc flash hazard analysis performed by the equipment manufacturer. Labels and label placement shall meet the requirements of NFPA 70E, shall be bi-lingual, and shall clearly identify and mark electrical equipment to warn workers from shock, arc flash and electrocution hazards. Labels shall include, but not be limited to, the following items.
   1. Arc-flash boundary.
   2. Flash hazard category (0-4).
   3. Minimum arc rating (cal/cm^2).
   4. Required personal protective equipment.

B. Warning labels shall be self-adhesive vinyl, 4 inches by 6 inches, and be as manufactured by Conney Safety products, or equal.

PART 3–EXECUTION

3.01 SUPERVISORY CONTROL CENTER–GENERAL

A. This control panel shall be a minimum of 20 inches wide by 20 inches deep by 90 inches high and be located in the MCC room where shown on the Drawings.

B. Telemetry panels shall be NEMA 12 painted steel, gasketed, factory wired, assembled, and tested with all transformers, logic circuits, terminal strips, and circuitry to provide control logic specified herein. All indicating lights, selector switches, elapsed time meters, etc. shall be installed on the front of the panel. Enclosure shall be front access only, hinged doors with rotating key locking handle with 3 point latch mechanism (not screws or bolts). Provide two keys to OWNER. Control panel accessories shall include fluorescent light and switch, and data pockets for wiring diagrams. Control panel shall be as manufactured by Hoffman, or equal.

C. Power supplies for radios installed in remote telemetry panels shall be powered through a normally closed control power relay contact. In the event that the remote PLC detects a data fail with the master radio, the PLC shall energize the control power relay that will deenergize power to the radio. The relay shall be energized for five seconds and then

deenergized. Data fail time delay shall be adjusted during start-up based on the quantity of remote telemetry panels.

D. Power supplies for radios installed in master telemetry panels shall be powered through a normally closed control power relay contact. In the event that the master PLC detects a data fail with all remote radios, the PLC shall energize the control power relay that will deenergize power to the radio. The relay shall be energized for five seconds and then deenergized. Data fail time delays shall be adjusted during start-up based on the quantity of remote telemetry panels.

E. UPSs installed in all supervisory control centers shall be provided as specified herein with a relay IO module that provides a dry contact output to the PLC in the event that the UPS batteries need replacement. Indication of "Replace UPS Battery" shall be provided at the SCADA system.

F. On each remote panel, provide a red, 30 mm, push-to-test indicating light on the front of the enclosure to indicate loss of communication with the master PLC.

G. Provide limit switches (door switch), as specified herein, wired to this SCC for building entry alarm. Provide lighted pushbutton (maintained type) on the front of the SCC so that when entering the building, the operator has one minute to press this button. Once pressed, the pushbutton will be illuminated, indicating the entry alarm system has been disabled. If the operator does not depress the pushbutton within the one-minute period, a building entry alarm shall be sent to the dialer. Upon leaving the building, the pushbutton must be depressed to extinguish the light, after which the operator has one minute to leave the building.

END OF SECTION

DRAWINGS

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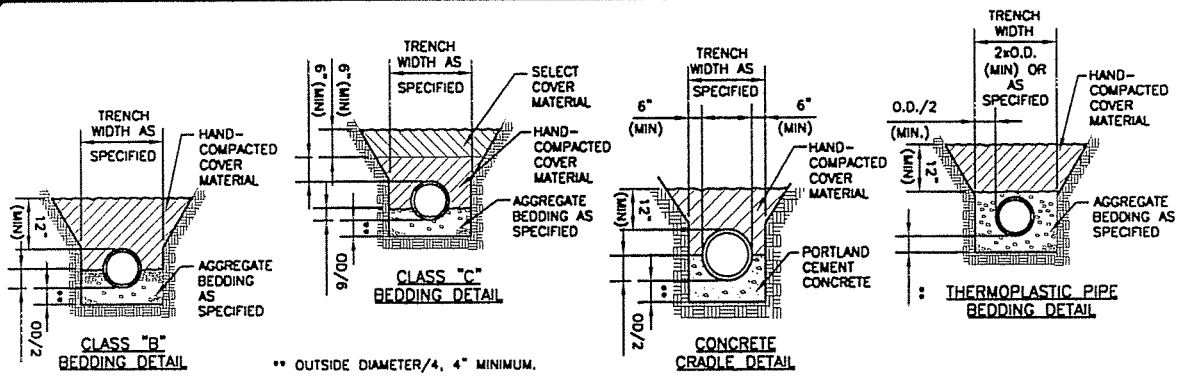
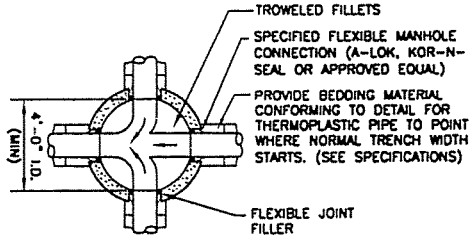
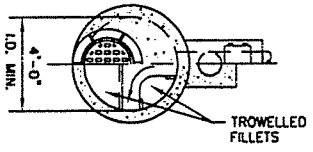
SANITARY SEWER APPURTENANCES

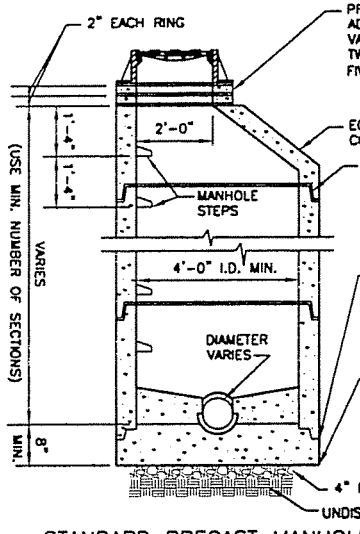
STANDARD DETAIL

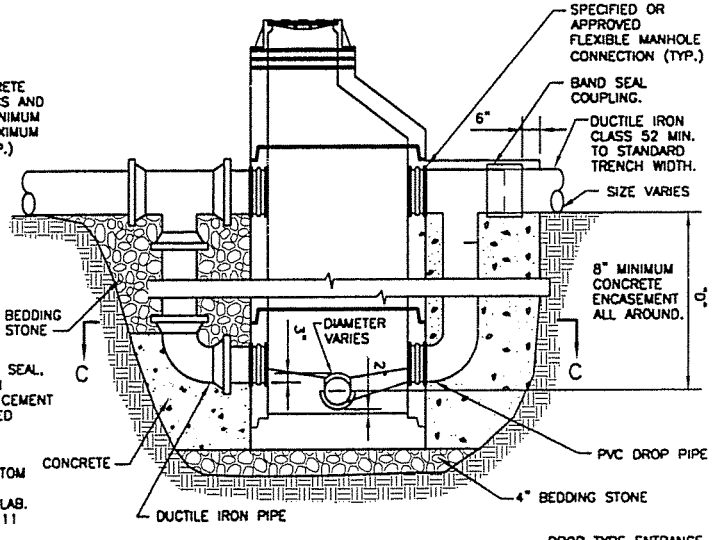


** OUTSIDE DIAMETER/4, 4" MINIMUM.









DROP TYPE ENTRANCE TO BE USED WHEREVER DIMENSION "D" EXCEEDS 2'-0".

NOTES

1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

2. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSABLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.

3. ALL CONCRETE FILLETS SHALL BE HAND TROWELED WITH A 1/4"/FT. SLOPE.

4. INSIDE DIMENSIONS FOR MANHOLES: USE MINIMUM 4' DIAMETER FOR SEWER LESS THAN 18" IN DIAMTER; USE MINIMUM 5' DIAMETER FOR SEWER 18" THRU 24" IN DIAMETER; USE MINIMUM 6' DIAMETER OR MINIMUM 6' SQUARE FOR SEWER OVER 24" IN DIAMETER.

5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.

6. DROP TYPE ENTRANCE TO STANDARD MANHOLE WILL BE PAID FOR SEPARATELY IF SO LISTED IN THE BID.

7. SEE DRAWINGS FOR DROP TYPE ENTRANCES FOR SANITARY SEWERS LARGER THAN 15".

8. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.

9. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.

10. FLAT SLAB TOPS SHALL BE DESIGNED FOR H-20 TRUCK LOADING AND SHALL MEET REQUIREMENTS OF ASTM C-478.

11. BASE SLABS SHALL BE REINFORCED AS FOLLOWS: REINFORCING SHALL BE PLACED IN EACH DIRECTION AT 2" CLEAR FROM TOP SURFACE OF SLAB. REINFORCING SHALL BE GRADE 60. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENTS TO PROVIDE WATERTIGHT JOINTS.

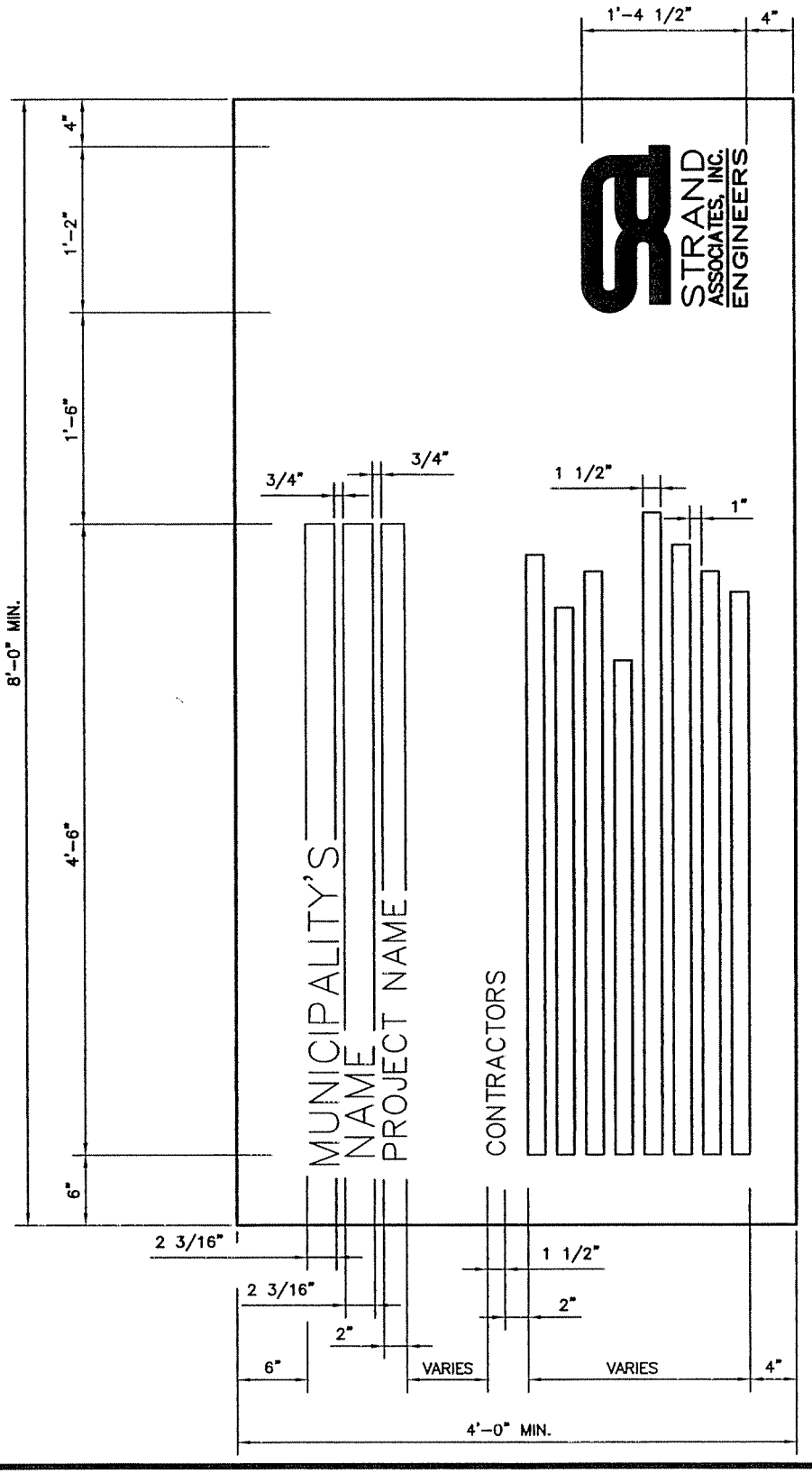
INSIDE DIA.	DEPTH	REINF.
4'	≤ 30'	#3@8"
5'	≤ 20'	#3@8"
5'	20'-30'	#4@10"
6'	≤ 20'	#4@10"
6'	20'-25'	#4@8"
6'	25'-30'	#4@6"

12. FLAT SLABS SHALL BE PROVIDED IN SHALLOW DEPTH SITUATIONS IN LIEU OF ECCENTRIC CONES.

STRAND ASSOCIATES, INC.® ENGINEERS

01-975-43A

DECEMBER 2003



NOTES:

BLUELINE FOR LOGO WILL BE FURNISHED TO CONTRACTOR FOR SIGN PAINTING.

SEE SPECIFICATIONS FOR SIGN CONSTRUCTION DETAILS AND SPECIAL REQUIREMENTS

STANDARD COLORS ARE TO BE AS NOTED:
"SA" LOGO = SLATE GRAY
LETTERING = BLACK
BACKGROUND = WHITE

PROJECT SIGN LAYOUT

STANDARD DETAIL

STRAND ASSOCIATES, INC.® ENGINEERS

01-975-158A

DECEMBER 2003

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SOIL BORINGS

TEST BORING RECORD LEGEND

FINE AND COARSE GRAINED SOIL INFORMATION

COARSE GRAINED SOILS (SANDS & GRAVELS)

N	Relative Density
0-4	Very Loose
5-10	Loose
11-20	Firm
21-30	Very Firm
31-50	Dense
Over 50	Very Dense

FINE GRAINED SOILS (SILTS & CLAYS)

N	Consistency	Qu, KSF Estimated
0-1	Very Soft	0-0.5
2-4	Soft	0.5-1
5-8	Firm	1-2
9-15	Stiff	2-4
16-30	Very Stiff	4-8
Over 31	Hard	8+

PARTICLE SIZE

Boulders	Greater than 300 mm (12 in)
Cobbles	75 mm to 300 mm (3 to12 in)
Gravel	4.74 mm to 75 mm (3/16 to 3 in)
Coarse Sand	2 mm to 4.75 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silts & Clays	Less than 0.075 mm

The **STANDARD PENETRATION TEST** as defined by ASTM D 1586 is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments with a 140 lb. hammer falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The blow counts required to drive the sampler the final two increments are added together and designate the N-value defined in the above tables.

ROCK PROPERTIES

ROCK QUALITY DESIGNATION (RQD)

Percent RQD	Quality
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

ROCK HARDNESS

Very Hard:	Rock can be broken by heavy hammer blows.
Hard:	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.
Moderately Hard:	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken with light hammer blows.
Soft:	Rock is coherent but breaks very easily with thumb pressure at sharp edges and crumbles with firm hand pressure.
Very Soft:	Rock disintegrates or easily compresses when touched; can be hard to very hard soil.

$$\text{Recovery} = \frac{\text{Length of Rock Core Recovered}}{\text{Length of Core Run}} \times 100$$

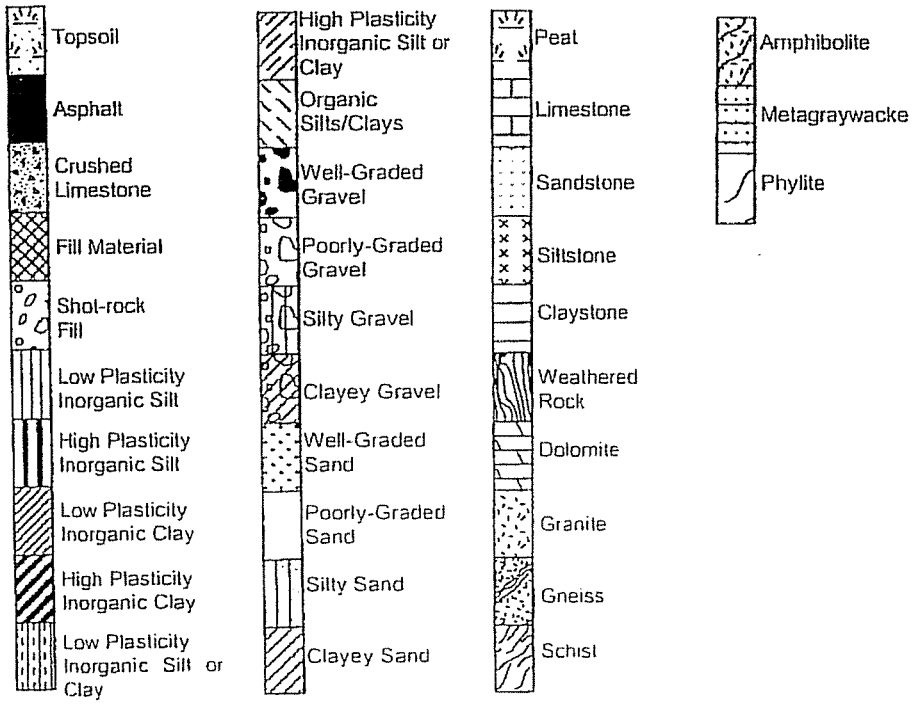
63 REC
NQ
43 RQD

$$\text{RQD} = \frac{\text{Sum of 4 in. and longer Rock Pieces Recovered}}{\text{Length of Core Run}} \times 100$$

Core Diameter	Inches
BQ	1-7/16
NQ	1-7/8
HQ	2-1/2

SYMBOLS

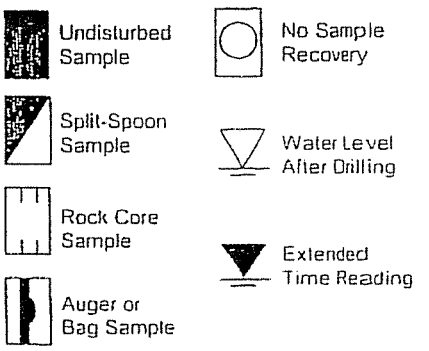
KEY TO MATERIAL TYPES



SOIL PROPERTY SYMBOLS

N:	Standard Penetration, BPF
M:	Moisture Content, %
LL:	Liquid Limit, %
PI:	Plasticity Index, %
Qp:	Pocket Penetrometer Value, TSF
Qu:	Unconfined Compressive Strength Estimated Qu, TSF
γ_D:	Dry Unit Weight, PCF
F:	Fines Content

SAMPLING SYMBOLS



QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: B-1

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 868.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	868.0	0								
	867.8		Topsoil - 2 inches			5				50/.4
	867.6		Fat Clay (CH) - Brown, moist Weathered Limestone							
	866.0		Auger Refusal at 2.0 feet Begin Coring Limestone with abundant mud seams, heavily water stained, light gray to white			58	8			
		5								
		10								
	857.6		Limestone with shale seams and interbedded shale, coarse grained, gray			74	46			
		15								
	851.3		Coring Terminated at 16.7 feet							
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

BORING NO: **B-2**

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 870.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	870.0	0	Topsoil - 5 inches							
	869.6		Fat Clay (CH), VERY STIFF, brown, moist			10			●	3 - 4 - 19
	868.6		Weathered Limestone							
	867.0		Auger Refusal at 3.0 feet Begin Coring Limestone with abundant mud seams, heavily water stained, light gray to white			43	37	935.9 ksf		
		5								
	861.2		Limestone with shale seams and interbedded shale, coarse grained, gray			116	56			
		10								
		15								
	853.2		Coring Terminated at 16.8 feet							
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-3**

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 877.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	877.0	0								
	876.6		Topsoil - 5 inches							
			Fat Clay (CH), STIFF, brown, moist			6			•	3 - 4 - 6
	874.7		Weathered Limestone							
	873.5		Auger Refusal at 3.5 feet Begin Coring							
			Limestone with abundant mud seams, heavily water stained, light gray to white. Low recovery			8	0			
		5								
	868.0		Limestone with abundant mud seams, heavily water stained, light gray to white			37	6			
		10								
	863.0		Limestone with shale seams and interbedded shale, coarse grained, gray			60	50			
		15								
	859.9		Coring Terminated at 17.1 feet							
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

BORING NO: **B-4**

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 877.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	877.0	0	Topsoil - 6 inches							
	876.5		Fat Clay (CH), FIRM, brown, moist			12			•	3 - 4 - 4
	873.8		Weathered Limestone							
	873.5		Auger Refusal at 3.5 feet Begin Coring							
		5	Limestone with abundant mud seams, heavily water stained, light gray to white			12	0	502.2 ksf		
						34	7			
		10								
						47	23			
	861.6	15	Limestone with shale seams and interbedded shale, coarse grained, gray							
						68	72			
		20								
	855.2		Coring Terminated at 21.8 feet							
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

BORING NO: B-5

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 878.0	BORING STARTED: 12/20/2006	BORING COMPLETED: 12/20/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	878.0	0								
	877.6		Topsoil - 5 inches		SS	13			●	3 - 3 - 5
			Fat Clay (CH), FIRM, brown, moist							
	874.8		Weathered Limestone							
	873.5		Auger Refusal at 4.5 feet Begin Coring							
		5	Limestone with abundant mud seams, heavily water stained, light gray to white			11	0			
						30	0			
		10								
	865.9		Limestone with shale seams and interbedded shale, coarse grained, gray			60	42			
		15						1633.3 ksf		
						60	66			
		20								
	855.9		Coring terminated at 22.1 feet							
		25								

CRAIG2 2430448B.GPJ QOR_CORP.GDT 1/11/07

QORE PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-6**

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 871.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	871.0	0	Topsoil - 6 inches							
	870.5		Fat Clay (CH), STIFF, brown, moist			16			●	2 - 4 - 6
	868.8		Weathered Limestone							
	867.1		Auger Refusal at 3.9 feet							
		5								
		10								
		15								
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-7**

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 878.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	878.0	0								
	877.6		Topsoil - 5 inches							
			Fat Clay (CH) - STIFF to VERY STIFF, light brown, moist			12				2 - 5 - 7
		5				14				5 - 7 - 12
	872.0		Weathered Limestone							
	871.3		Auger Refusal at 6.7 feet							
		10								
		15								
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

BORING NO: **B-8**

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 876.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	876.0	0	Topsoil - 5 inches							
	875.6		Fat Clay (CH), STIFF, brown, moist			10			●	3 - 4 - 6
	873.5		Weathered Limestone							
	872.5		Auger Refusal at 3.5 feet							
		5								
		10								
		15								
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-9**

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 867.0	BORING STARTED: 12/20/2006	BORING COMPLETED: 12/20/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	867.0	0								
	866.7		Topsoil - 4 inches							
			Fat Clay (CH), STIFF, moist, brown			9			●	4 - 5 - 4
	864.7		Weathered Limestone							
	863.3		Auger Refusal at 3.7 feet Begin Coring							
		5	Limestone with abundant mud seams, heavily water stained, light gray to white			10	0			
						11	0			
		10								
	854.5		Limestone with shale seams and interbedded shale, coarse grained, gray			58	70			
		15								
						64	45			
		20								
	845.5		Coring Terminated at 21.5 feet							
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-10**

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 871.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	871.0	0								
	870.5		Topsoil - 6 inches							
			Fat Clay (CH), brown, moist			10				2 - 4 - 6
	867.8		Weathered Limestone							
	867.2		Auger Refusal at 3.8 feet							
		5								
		10								
		15								
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

BORING NO: **B-11**

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 860.0	BORING STARTED: 12/19/2006	BORING COMPLETED: 12/19/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	860.0	0	Topsoil - 5 inches							
	859.6		Fat Clay (CH) - STIFF, brown, moist			12				3 - 4 - 5
		5				16				3 - 5 - 6
	854.3		Weathered Limestone							
	853.9		Auger Refusal at 6.1 feet							
		10								
		15								
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

BORING NO: **B-12**

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 850.0	BORING STARTED: 12/20/2006	BORING COMPLETED: 12/20/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	850.0	0	Topsoil - 2 inches							
	849.8		Fat CLAY (CH) with rock fragments, STIFF to VERY STIFF, light brown, moist to wet			11			•	2 - 3 - 4
		5				16			•	6 - 9 - 14
	844.0		Auger Refusal at 6.0 feet							
		10								
		15								
		20								
		25								

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BORING NO: **B-13**

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 841.0	BORING STARTED: 12/20/2006	BORING COMPLETED: 12/20/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	841.0	0	Topsoil			15				2 - 9 - 5
	840.2		Fat Clay (CH), STIFF, brown, moist							
	838.3		Weathered Limestone							
	837.8		Auger Refusal at 3.2 feet							
		5								
		10								
		15								
		20								
		25								

CRAIG2 24304488.GPJ QOR_CORP.GDT 1/11/07

QORE™ PROPERTY SCIENCES

BORING NO: **B-14**

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 851.0	BORING STARTED: 12/20/2006	BORING COMPLETED: 12/20/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	851.0	0	Topsoil - 5 inches							
	850.6		Fat Clay (CH), STIFF, brown, moist to wet			10			●	3 - 7 - 8
	848.7		Weathered Limestone							
	847.9		Auger Refusal at 3.1 feet							
		5								
		10								
		15								
		20								
		25								

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BORING NO: **B-15**

QORE™ PROPERTY SCIENCES

TEST BORING RECORD

PROJECT: Franklin County Pump Station and Water Tank	JOB NO: 24304488	REPORT NO:
PROJECT LOCATION: Franklin County, Kentucky		
ELEVATION: 864.0	BORING STARTED: 12/20/2006	BORING COMPLETED: 12/20/2006
DRILLING METHOD: 4" HSA	RIG TYPE: Diedrich D-120	HAMMER: Automatic
GROUNDWATER (ft): Dry upon completion of boring	BORING DIAMETER (IN): 4	SHEET 1 OF 1

Remarks: Sunny, clear, 30s - 40s
Elevation interpolated from topographic site map

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50	BLOWS /6"
	864.0	0	Topsoil - 3 inches			10				4 - 50/.4
	863.7		Fat Clay (CH), FIRM, brown, moist							
	863.0		Auger Refusal at 1.0 feet							
		5								
		10								
		15								
		20								
		25								

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