



**INVITATION TO BID
No. 201816**

**PERCY D. MILLER WATER TREATMENT PLANT
RAW WATER PUMP STATION GENERATOR REPLACEMENT**

**FOR THE
DEPARTMENT OF PUBLIC SERVICES**

Project Manual
Contract Documents
Specifications
August 2018

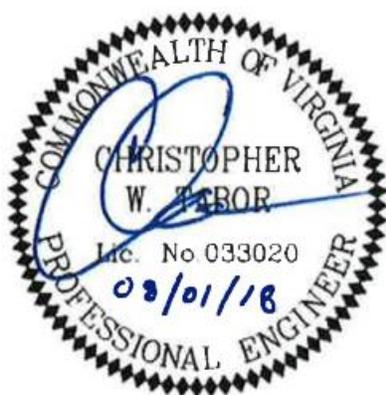
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**FOR THE
DEPARTMENT OF PUBLIC SERVICES**



**Approved By Christopher Tabor
Division 01**



**Approved By Joel Petery
Division 02 through 15**



**Approved by David Atkinson
Division 16**

**Project Manual
Contract Documents
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City of Winchester
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ITB# 201816
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	16118	Underground Electrical
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INVITATION TO BID

Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

ITB # 201816

The City of Winchester is submitting this Invitation to Bid to establish a contract with qualified Contractors furnishing all labor, equipment, transportation and materials necessary for the following project:

Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

Work includes the replacement of an existing 750 kW standby generator with a new 1000 kW Generator. Project components include but are not limited to: removal of existing 2500 gallon buried fuel oil tank, construction of new 6000 gallon above ground dual wall steel fuel oil tank, addition of fuel monitoring and treatment equipment, new power and control connections to existing electrical distribution equipment, generator lighting, equipment pads, and site restoration.

A **mandatory** pre-bid meeting will be held on **Wednesday, September 5, 2018 at 11:00 A.M.** at the Percy D. Miller Water Treatment Plant - 32 Pence Land Road, Middletown VA, 22645. Due to the importance of all respondents having a clear understanding of the specifications/scope of work and requirements of this solicitation, attendance at this conference will be a prerequisite for submitting a proposal. Proposals will only be accepted from those respondents who are represented at this pre-bid meeting. Attendance at the meeting will be evidenced by the representative's signature on the attendance roster. No one will be admitted after 11:05 A.M. (local time).

Contract Specifications may be obtained from the below address and all bids shall be received at:

City of Winchester, Virginia
Finance Department - Purchasing Division
Rouss City Hall, 4th Floor
15 North Cameron Street
Winchester, Virginia 22601
Telephone (540) 667-2378

The contract documents and drawings may be downloaded at no cost from the City's website at:

<http://www.winchesterva.gov/purchasing/itbrfp.php>

Any questions regarding the contract documents or drawings shall be sent **in writing via e-mail** to:

Kelly Henshaw: kelly.henshaw@winchesterva.gov

Bid prices shall be made on the blank Bid Form provided herein. Bids shall be delivered to the above address on or before **3:00 P.M. (local time) on Thursday, September 20, 2018**, at which time the bids shall be publicly read aloud.

Bids will be received only from contractors who are registered in the Commonwealth of Virginia. **Bidders shall indicate on the outside of the envelope containing the Bid their current Virginia Contractor's**

Registration Number. Bids without this information on the outside of the envelope may be non-responsive.

Each Bid shall be accompanied by complete response to the Contractor Qualification Data Sheet. The successful bidder shall meet the minimum qualifications specified in the Contractor Qualification Data Sheet. A bid from a bidder that does not meet the minimum qualifications specified in the Contractor Qualification Data Sheet, as determined by the City, shall be non-responsive.

Each Bid shall also be accompanied by a satisfactory Bid Guarantee in the amount of 5% of the bid, in the form of a certified or cashier's check drawn on a bank chartered under the laws of the Commonwealth of Virginia; payable to the Treasurer of the City of Winchester, or a Bid Bond, as a guarantee that the bidder will within fifteen (15) days after the date of the award of the Contract, execute an agreement and file insurance as required by the Contract Documents if his proposal is accepted. If the successful bidder fails to execute and file the agreement and insurance, the amount of the Bid Guarantee shall be forfeited. Bids without a satisfactory Bid Guarantee shall be rejected.

Performance and Payment Bonds will be required of the successful bidder, each in an amount equal to one hundred (100) percent of the amount of the Contract, conditioned upon the faithful performance of the Contract and to the payment in full to all persons furnishing labor, materials, equipment, etc., for and in connection with the work to be performed under the contract.

Bidder desiring to withdraw his bid after the bid opening procedure, shall give notice in writing of his claim of right to withdraw his bid within two (2) business days after the conclusion of the bid opening procedure. Bidder shall submit to the City his original work papers; documents and materials used in preparation of the bid sought to be withdrawn. Bidder withdrawing his bid that does not meet these requirements shall forfeit their bid bond.

The City of Winchester reserves the right to reject any proposal for failure to comply with all requirements of this notice or any of the Contract Documents; however, it may waive any minor defects or informalities at its discretion. The City further reserves the right to reject any and all proposals, cancel the ITB at any time prior to award or to award a contract that in its judgment is in the best interest of the City.

CITY OF WINCHESTER, VIRGINIA

BY: Mike Marzullo, Purchasing Agent

**Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator
Replacement**

INSTRUCTIONS TO BIDDERS

1. OWNER AND ENGINEER:

The Owner is the City of Winchester Department of Public Services, which shall be represented by the City Engineer or his designee who shall perform the duties of the Engineer. Telephone: Department of Public Services, (540) 667-1815, extension 1481.

2. COPIES OF CONTRACT DOCUMENTS:

2.01 Bidding Documents may be examined and downloaded from the City's website at <http://www.winchesterva.gov/purchasing/itbrfp> at no charge.

City of Winchester, Virginia
Finance Department - Purchasing Division
Rouss City Hall, 4th Floor
15 North Cameron Street
Winchester, Virginia 22601
Telephone: (540) 667-2378

2.02 Complete set of Bidding Documents shall be used in preparing bids; neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents. 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. EXAMINATION OF CONTRACT DOCUMENTS AND SITE:

3.01 Before submitting a bid, each bidder must examine the Contract Documents thoroughly, visit the site to familiarize himself with local conditions that may in any manner affect cost, progress, or performance of the work, familiarize himself with federal, state, and local laws, ordinances, rules, and regulations that may in any manner affect cost, progress, or performance of the work; and study and carefully correlate bidder's observations with the Contract Documents.

3.02 Before submitting his bid, each bidder will, at his own expense, make such additional investigations and tests as the bidder may deem necessary to determine his bid for

performance of the work in accordance with time and other terms and conditions of the Contract Documents. The Contractor shall be responsible for taking his own borings or making any investigations he requires to establish subsurface conditions in the area of this Contract. The City does not assume any responsibility for the subsurface conditions which may be encountered. On request, Owner will provide each bidder access to the site to conduct such investigations.

- 3.03 The submission of a bid will constitute an incontrovertible representation by the bidder that he has examined the site and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions of the Work.
- 3.04 It is understood and agreed by the bidder that the estimate of quantities (if provided) are approximate, and are presented in order to obtain unit prices and approximate amount of the Contract. The Contractor shall make no claim against the City because of any estimate, tests or representations made by any officer or agent of the City, which may prove to be in any respect erroneous.
- 3.05 Scope of the work is as specified herein. The Owner, however, reserves the right to make adjustments to the scope of the work. Such adjustments shall be accomplished by appropriate Change Orders.

4. **SPECIFICATIONS:**

The technical specifications for the project are provided within this contract document.

5. **INTERPRETATIONS:**

All questions about the discrepancies or ambiguities in the Contract Documents prior to the bid opening shall be submitted in writing via e-mail to the following:

Kelly Henshaw, City Engineer: kelly.henshaw@winchesterva.gov

Replies to questions will be issued by Addenda mailed or delivered to all parties recorded by the Purchasing Agent as having received the Bidding Documents or by posting on a Question and Answer Bulletin Board posted at the following location:

<http://www.winchesterva.gov/purchasing/itbrfp>

Questions received less than five (5) calendar days prior to the date for opening of bids may not be answered. Only questions answered by formal written Addenda or in

writing on the Question and Answer Bulletin Board will be binding.

6. **REQUIRED BOND - BID GUARANTEE:**

6.01 Bid Guarantee shall be made payable to Owner, in an amount of five percent (5%) of the bidder's maximum bid price and in a form of a certified or cashier's check drawn on a bank chartered under the laws of the Commonwealth of Virginia; payable to the Treasurer, City of Winchester, or a Bid Bond issued by a surety having registered resident agents in Virginia.

6.02 The Bid Guarantee of the successful bidder will be retained until such bidder has executed the Agreement and furnished the required Contract Security, whereupon it will be returned. If the successful bidder fails to execute the agreement and furnish the required Contract Security within fifteen (15) calendar days of the Notice of Award, Owner may annul Notice of Award and the Bid Guarantee of the bidder will be forfeited.

7. **REQUIRED BONDS – PAYMENT AND PERFORMANCE:**

Performance and Payment Bonds will be required of the Successful bidder, each in an amount equal to one hundred percent (100%) of the amount of the Contract, conditioned upon the faithful performance of the Contract and to the payment in full to all persons furnishing labor, materials, equipment, etc., for and in connection with the work to be performed under the Contract.

8. **CONTRACT TIME:**

Contractor agrees that all work shall be completed within 270 calendar days following the Notice to Proceed.

Owner and Contractor recognize that the time is of essence in this Contract, and if the work is not completed within the specified times outlined above, plus any extensions allowed, then the Contractor shall pay, as liquidated damages, \$1,000.00 for each calendar day that expires after the specified completion date.

9. **PAYMENT PROCEDURE:**

9.01 The basis for payment shall be the actual percentage of work completed, as determined in the field by the Engineer.

9.02 An amount equal to five percent (5%) of each progress payment shall be held from each payment as retainage.

10. SUBCONTRACTORS:

10.01 The apparent successful bidder and any other bidder so requested, will within seven (7) days after the day of bid opening submit to Owner a list of all subcontractors and other persons and organizations, including those who are to furnish the principal items of material and equipment, proposed for the work. Such list shall be accompanied by an experience statement with pertinent information as to similar projects and other evidence of qualification for each such subcontractor, person, and organization. If Owner or Engineer, after due investigation has reasonable objection to any proposed subcontractor, other person or organization, either may before giving the Notice of Award request the apparent successful bidder to submit an acceptable substitute without an increase in Bid price. If the apparent successful bidder declines to make any such substitution, the Contract shall not be awarded to such bidder, but his declining to make any such substitution will not constitute grounds for sacrificing his Bid Bond. Any subcontractor, other person, or organization so 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.

10.02 No Contractor shall be required to employ any subcontractor, other person, or organization against whom he has reasonable objection.

11. SUBSTITUTE MATERIAL AND EQUIPMENT

11.01 Whenever it is indicated in the Contract Documents that a substitute or "or equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered until after the Effective Date of the Contract Agreement. The procedure for submittal of any such application by Contractor and consideration by Engineer is set forth in the General Conditions.

12. PREPARATION OF BID:

12.01 The Bid Form is included in these Specifications, and may not be altered in any way. Additional copies may be obtained from the City of Winchester.

12.02 Bid Forms must be completed in ink or by typewriter. The Total Base Bid price must be stated in words and numerals; in case of conflict, words will take precedence.

12.03 A. Bids MUST give full firm name and address of bidder. Failure to manually sign bid may disqualify it. Person signing bid will show TITLE or AUTHORITY TO BIND THE FIRM IN A CONTRACT. Firm name and authorized signature must appear on bid in the space

provided on the bid form. Those authorized to sign are as follows:

If a sole proprietorship, the owner may sign.

If a general partnership, any general partner may sign.

If a limited partnership, a general partner must sign.

If a limited liability company, a "member" may sign or a "manager" must sign if so specified by the articles or organization.

If a regular corporation, the CEO, President or Vice-President must sign.

Others may be granted authority to sign but the City requires that a corporate document authorizing him/her to sign be submitted with bid.

B. Contractor's license or registration number shall be entered in the space provided on the Bid Form.

C. A bidder or offeror organized or authorized to transact business in the Commonwealth pursuant to Title 13.1 or Title 50 of the Code of Virginia shall include in its bid or proposal the identification number issued to it by the State Corporation Commission (SCC). Any bidder or offeror that is not required to be authorized to transact business in the Commonwealth as a foreign business entity under Title 13.1 or Title 50 of the Code of Virginia or as otherwise required by law shall include in its bid or proposal a statement describing why the bidder or offeror is not required to be so authorized. Any bidder or offeror described herein that fails to provide the required information may not receive an award unless a waiver of this requirement and the administrative policies and procedures established to implement this section is granted by the City Manager. The SCC may be reached at (804) 371-9733 or at <http://www.scc.virginia.gov/default.aspx>.

12.04 Bidder shall make acknowledgement on the Bid Form of receipt of all Addenda, the numbers of which shall be filled in the Bid Form.

SUBMISSION OF BIDS:

13.01 Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be included in an opaque sealed envelope, along with the Bid Bond, Non-collusion Affidavit, and other required documents. The sealed envelope shall indicate the Project Title, name and address of the bidder, and State Registration No. of the bidder. 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 thereof.

13.02 Timely delivery of the Bid shall be the sole responsibility of the Bidder. Bids must be received not later than the time and date stated in the Invitation to Bid. Bids by telephone, facsimile or other forms shall not be accepted.

14. **MODIFICATION AND WITHDRAWAL OF BIDS:**

14.01 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 opening of the bids. The request for withdrawal or modification must be in writing and signed by a person duly authorized to do so.

14.02 No bidder may withdraw his bid within thirty (30) calendar days after the actual date of the bid opening, except as allowed by the Code of the City of Winchester, Virginia, Section 21-43(a), which states "the Bidder shall give notice in writing of his claim of rights to withdraw this bid within two (2) business days after the conclusion of the bid opening procedure". Bidder shall submit to the Owner his original work papers, documents and materials used in preparation of his bid sought to be withdrawn.

OPENING OF BIDS:

- 14.03 Bids shall be opened publicly, and will be read aloud at the time and location indicated on the Invitation to Bid. An abstract of the amounts of the Bids shall be made available after the opening of bids.
- 14.04 All bids shall remain open for sixty (60) days after the day of the bid opening, but Owner may, in his sole discretion, release any bid and return the Bid Bond prior to that date.

AWARD OF CONTRACT:

- 14.05 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, or conditional bids. Discrepancies between words and figures shall be resolved in favor of words. Discrepancies between indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.
- 14.06 In evaluating bids, Owner will consider the qualifications of the bidders, whether or not the bids comply with the prescribed requirements, and alternates and unit prices if requested in the Bid Form. Owner may consider the qualifications and experience of subcontractors and other persons and organizations proposed for the work.
- 14.07 Owner may conduct such investigations as he deems necessary to assist in the evaluation of any bid and to establish the responsibility, qualifications, and financial ability of the bidders, proposed subcontractors and other persons and organizations, to do the work in accordance with the Contract Documents and to the Owner's satisfaction within the prescribed time.
- 14.08 Owner reserves the right to reject the bid of any bidder who does not pass any such evaluations to Owner's satisfaction.
- 14.09 If the Contract is to be awarded, it will be awarded on a Base Bid price basis to the lowest responsive and responsible bidder, and whose evaluation by the Owner indicates that the award will be in the best interest of the Project and the City. Discounts for prompt payment, liquidated damages, and cash incentives will not be part of the award.

15. **NEGOTIATION WITH THE LOWEST BIDDER:**

Unless all bids are cancelled or rejected, the City of Winchester reserves the right granted by § 2.2-4318 of the *Code of Virginia* to negotiate with the lowest responsive, responsible bidder to obtain a contract price within the funds available to the agency whenever such low bid exceeds the agency's available funds. For the purpose of determining when such negotiations may take place, the term "available funds" shall mean those funds which were budgeted by the agency for this contract prior to the issuance of the written Invitation for Bids. Negotiations with the low bidder may include both modifications of the bid price and the Scope of Work/Specifications to be performed. The agency shall initiate such negotiations by written notice to the lowest responsive, responsible bidder that its bid exceeds the available funds and that the agency wishes to negotiate a lower contract price. The times, places, and manner of negotiating shall be agreed to by the agency and the lowest responsive, responsible bidder.

16. **SIGNING OF CONTRACT:**

Owner shall give Notice of Award to the successful bidder accompanied by at least three (3) unsigned counterparts of the Contract and all other Contract Documents. Within fifteen (15) days thereafter, Contractor shall sign and deliver at least three (3) counterparts of the Contract to the Owner with all other Contract Documents attached. Within ten (10) days thereafter, Owner will deliver all fully signed counterparts to Contractor. Engineer will identify those portions of the Contract Documents not fully signed by Owner and Contractor and shall ensure that all parties appropriately execute all required portions of the contract immediately.

*** * * END OF SECTION * * ***

BID FORM
Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement
ITB# 201816

This Bid is submitted to:

City of Winchester, Virginia
Finance Department - Purchasing Division
Rouss City Hall
15 North Cameron Street
Winchester, Virginia 22601

In submitting this Bid, bidder acknowledges that the bidder has examined copies of the following Contract Documents:

BIDDING DOCUMENTS

- Invitation to Bid
- Instructions to Bidders
- Bid Form
- Contractor Qualification Data Sheet
- Bid Bond
- Non-Collusion Affidavit
- Contract
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- E-2 Electrical Site Plan
- E-3 Electrical One-Line Diagram
- E-4 Electrical Details
- E-5 Pump Station Electrical Power Plan
- E-6 Control One-Line Diagrams
- E-7 Electrical Schedules

ADDENDA:

<u>NUMBER</u>	<u>DESCRIPTION</u>	<u>DATE</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

Receipt of all of above is hereby acknowledged.

CONTRACTOR: _____
 BY (SIGNATURE): _____
 NAME AND TITLE: _____
 DATE: _____

BID ITEMS/QUANTITIES

- (a) The Contractor shall provide all unit prices or lump sum prices for all bid items on the Bid Form herein. **If a unit price or lump sum price is omitted or left blank the bid and bidder shall be non-responsive.** The bid forms designate which prices are for *Install* only work, complete and in place, (i.e. assumes equipment and/ or materials will be supplied by the City). All other bid prices are for Furnish and Install work, complete and in place.
- (b) The quantities shown for unit bid items are based upon the best information available at time of preparation of these bid documents, and are established for the purpose of obtaining a bid price. No adjustments to the bid prices based on changes to quantities will be considered. All bid prices will be held throughout the duration of the contract regardless of any increase or decrease in bid quantity.
- (c) Emergency work shall be negotiated with a maximum allowable amount of 50% over the bid price by item. This excludes all lump sum bid items.

- (d) All other bid items not listed or described in the Contract Documents will be negotiated between the City and the Contractor before the time of need. Once a negotiated price is established, it will be used for the remainder of the contract.

The undersigned Bidder proposes to complete all work in accordance with the Contract Documents for the following unit prices:

City of Winchester

Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement – ITB #201816

BID TABLE

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
General Construction					
1	General Construction of the Work as Shown and Specified Under Divisions 1 Through 16	1	Lump Sum		
Additional Excavation					
2	Additional Excavation of Unsuitable Materials, Including Disposal [Only as directed by City]	20	Cubic Yard		
Additional Backfill With VDOT 21A Stone					
3	Additional Backfill of Excavated Areas [Only as directed by City]	20	Cubic Yard		
TOTAL FOR ALL – BASE BID					

TOTAL BASE BID: \$ _____

IN WORDS:

CONTRACTOR: _____

BY: (SIGNATURE) _____

NAME AND TITLE: _____

DATE: _____

ADDRESS: _____

TELEPHONE: _____

CURRENT VIRGINIA CONTRACTOR REGISTRATION NUMBER: _____

NOTE: REQUIRED BID GUARANTEE MUST BE ENCLOSED WITH THIS BID PROPOSAL.

Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement
ITB# 201816

CONTRACTOR QUALIFICATION DATA SHEET

1. General:

In order to be considered for selection, Bidders shall submit the following information as part of your response to this solicitation. Failure to complete and provide this data sheet and the requested information may result in a non-responsive bid.

1.1 Proprietary Information

All source code, executables, user data, materials, meeting minutes, progress reports and documentation shall be submitted to the City and shall belong exclusively to the City, and shall be subject to public inspection in accordance with the Virginia Freedom of Information Act. Trade secrets or proprietary information submitted by a Bidder shall not be subject to public disclosure under the Virginia Freedom of Information Act provided the Bidder invokes the protections of Section 2.2-4342F of the Virginia Public Procurement Act, which provides that:

“Trade secrets or proprietary information submitted by a Bidder, or subsequently the Contractor, in connection with a procurement transaction, shall not be subject to public disclosure under the Virginia Freedom of Information Act. However, the Bidder or Contractor must invoke the protection of this Section prior to, or upon submission of the data or other materials. The Contractor must identify the data or other materials to be protected and justify in writing the explicit reasons that such protection is necessary. Failure to mark the data or other materials as proprietary or otherwise classified, will result in the data or other materials being released to Bidders or to the public as provided in the Virginia Freedom of Information Act.”

The classification of the entire proposal document and total bid price as proprietary or trade secrets is not acceptable.

1.2 Incurred Cost

The Bidder is responsible for all costs of proposal preparation. The City of Winchester is not liable for any costs incurred in response to the ITB.

1.3 Contractor Qualifications:

Proposals should be as thorough and detailed as possible so that City may properly evaluate your capabilities to provide the required services. Bidders shall submit responses for the following items within your Bid response.

1.3.1 General

1.3.1.1 How many years has your organization been in business as a General Contractor?

1.3.1.2 How many years has your organization been in business under its present name?

1.3.1.3 What is your organization’s Virginia Contractors Registration Number?

1.3.1.4 List the states and categories of construction in which your organization is legally qualified to do business?

1.3.1.5 *Qualifications:* Provide a description of the organizational structure and history. Identify key personnel to be assigned to this project and their relevant experience in work similar to this project.

1.3.1.6 *Debarment/Suspension List:* Firms shall confirm in writing that they are not currently on any debarment or suspension list of any local, state or federal government. Any firm found to be listed shall be rejected as non-responsive.

1.3.2 Construction-Specific

1.3.2.1 *Quality Management Plan and Timeliness Tracking Plan*

The Contractor shall provide a detailed description of all internal control methods used to insure quality throughout all of the contractor's operations, as well as the system or method that will be employed to track, monitor, and ensure compliance with all time line requirements of this ITB.

1.4.2.2 *Past Project Experience*

The Contractor shall provide a minimum of three (3) references that are similar in nature to the City's proposed construction project. The City prefers that contractors have significant experience **in electrical construction**. The submitted projects shall have been initiated or completed in the past five (5) years and exceed **\$500,000** of total value. In the response, the Contractor shall provide a one to two paragraph description of the work performed, and the name, address, telephone number, and email address of the owner's representative. For each reference, the response shall also delineate the specific value of the underground utility installations, as defined above, as well as the total value of all the work completed.

The Contractor shall include in this list any contract(s) in the past five (5) years that were terminated and shall provide the reason for termination.

1.4.2.3 *Management of Simultaneous Contracts*

The Contractor shall list all the name of projects, owner's name and address, percent complete and scheduled completion of the major projects in progress on the date of proposal submittal and the estimated contract amount of all executed contracts that will be underway at the same time as the City's proposed construction project. The contractor shall also state how the contract needs of the City will be met with the available company resources considering that these other contracts will be underway simultaneously.

1.4.3 Financial Statements

Please submit your company's audited annual financial statement and/or Dunn & Bradstreet report for the last two (2) years.

1.4.4 Subcontracting Restrictions

The Prime Contractor shall perform or exercise responsibility for this contract with its own work force for at least 50% of the total dollar value of the contract. Identify the sub-Contractor(s) who will do work on this project and the amount of work that each is projected to perform.

1.4.5 Certification

ITB #201816 - Contractor Qualifications

An authorized representative of the company shall sign the Technical Proposal, which shall include the following statement above the name/signature/date line:

I certify that the information provided in the Contractor Qualifications is complete and accurate to the best of my knowledge.

Authorized Signature

Title

Date

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BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____

(Here insert the name & address or legal title of the Contractor)

as Principal, hereinafter called the Contractor and _____

(Here insert the legal title of the Surety)

as Surety, hereinafter called the Surety, are held and firmly bound unto the City of Winchester, Virginia, as obligee, hereinafter called the Owner, in the amount of

(Dollars)

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

WHEREAS, the Principal has submitted a Bid for:

ITB #201816– Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

in accordance with Drawing and Specifications prepared by the Public Services Department, City of Winchester, Virginia.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Obligees shall accept the Bid of the Principal and the Principal shall enter into a Contract with the Obligees in accordance with terms of such Bid, and give such bonds as specified in the Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bonds, if the Principal shall pay the Obligees the difference not to exceed

the penalty hereof between the amount specified in said Bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said Bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

SIGNED AND SEALED THIS _____ DAY OF _____ A.D., 2018.

PRINCIPAL

TITLE

WITNESS

SURETY

TITLE

WITNESS

NON-COLLUSION AFFIDAVIT

STATE OF VIRGINIA

Ss: ITB #201816 – Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

CITY OF WINCHESTER, COUNTY of FREDERICK

I, _____ of the City of _____

In the County of _____ and the State of _____

Of full age, being duly sworn according to law or my oath depose and say that:

I am _____ of the firm of _____

_____, of the Company making the Bid for the above named project, and that I executed the said Bid with full authority to do so; that the Company has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bid preparation in connection with the above named project; and that all statements contained in said Bid and in this affidavit are true and correct, and made with full knowledge that the City of Winchester relies upon the truth of the statements contained in said Bid and in the statements contained in this affidavit in awarding the Contract for said Project.

I further warrant that no person or selling agency has been employed or retained to solicit or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, except bona fide employees or bona fide established commercial or selling agencies maintained by:

(Name of Contractor)

Subscribed and sworn to _____
(Type or print name of applicant under signature)

before me this _____ day of _____, 20_____.

(Notary Public)

of _____

My commission expires: _____, 20____.

**Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator
Replacement- ITB # 201816**

CONTRACT

THIS CONTRACT, made and entered into in triplicate originals this ____ day of _____, 2018, by and between the **City of Winchester, Virginia**, Party of the First Part, hereinafter referred to as the "**Owner**" and _____, Party of the Second Part, hereinafter referred to as the "**Contractor**".

WITNESSETH, That the Contractor and the City for the consideration stated herein agree as follows:

ARTICLE I, SCOPE OF WORK - The Contractor shall perform everything required to be performed and shall provide and furnish all of the labor, materials, necessary tools, expendable equipment and all utility and transportation services required to perform and complete in a workmanlike manner all the work required in connection with:

**ITB #201816 – Percy D. Miller Water Treatment Plant Raw Water Pump Station
Generator Replacement**

all in strict accordance with the Contract Documents prepared by the Public Services Department, City of Winchester, Virginia. The Contractor shall do everything required by this Contract and other Documents constituting a part thereof.

ARTICLE II, CONTRACT PRICE - The City shall pay to the Contractor for the performance of this Contract, subject to any additions or deductions provided therein, in current funds, the Contract Price computed as follows:

TOTAL CONTRACT PRICE= _____

ARTICLE III. PAYMENTS - Payments are to be made to the Contractor in accordance with and subject to provisions embodied in the Documents made a part of this Contract.

ARTICLE IV. CONTRACT TIME - Work under this Contract shall commence no later than the date to begin work set forth in a written Notice to Proceed from the City or its authorized representative, to the Contractor. The Contractor shall complete all work under this Contract within 270 calendar days following the Notice to Proceed issued for the project.

The Work shall be prosecuted (performed) regularly, diligently and uninterruptedly at

such rate of progress as will insure full completion thereof within the time specified. **It is expressly understood and agreed by and between the Contractor and the City that the time for the completion of the Work described herein is a reasonable time for the completion of the same.**

ARTICLE V. ENGINEER – The project has been designed by Hazen and Sawyer, 1555 Roseneath Road, Richmond VA 23230, who is hereinafter called ENGINEER and 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 VI. HOLD HARMLESS CLAUSE - Bids shall provide that during the term of the Contract, including warranty period, for the successful bidder indemnifying, defending, and holding harmless the City, its officers, employees, agent and representatives thereof from all suits, actions, claims of any kind, including attorney's fees, brought on account of any personal injuries, damages, or violation of rights sustained by any person or property in consequence of any neglect in safeguarding contract work, or on account of any act or omission by the Contractor or his employees, or from any claims or amounts arising from violation of any law, bylaw, ordinance, regulation or decree. The Contractor agrees that this clause shall include claims involving infringement of patent or copyrights.

ARTICLE VII. LIQUIDATED DAMAGES AND INCENTIVES - **It is hereby fully understood and agreed that the time is of essence in the performance of this Contract.** For each and every calendar day that elapses between the Contract Completion Dates specified in Article IV of this Contract and the date on which the work covered by such Contract is actually completed, including the removal of all plant and obstructions from the site of such work, the Contractor shall pay to the City as liquidated damages and not as a penalty, the sum of ONE THOUSAND DOLLARS PER CALENDAR DAY (\$1,000.00). The total amount so payable by the Contractor as liquidated damages either may be deducted from any moneys due or payable to the Contractor by the City or so much thereof as is not so deducted shall be chargeable to and will be payable promptly by such Contractor and his Surety, or either of them, to the City. Such liquidated damages shall be payable to reimburse or compensate, at least in part, the City for (1) the administration of the work covered by such Contract and any other contract or contracts beyond the Contract Completion Date, including the additional expense to the City for supervision, inspection, and superintendence; (2) expenditures resulting from the inability of the City (and the general public) to use the improvement being constructed from and after such Contract Completion Date until the actual date of completion; (3) other miscellaneous obligations and expenditures incurred by the City directly as a result of the failure to complete the Work covered by such Contract on or

before the Contract Completion Date.

ARTICLE VIII. COMPONENT PARTS OF THIS CONTRACT - That this Contract consists of the following component parts which are made a part of this agreement and Contract as fully and absolutely as if they were set out in detail in this Contract:

BIDDING DOCUMENTS

- Invitation to Bid
- Instructions to Bidders
- Bid Form
- Contractor Qualification Data Sheet
- Bid Bond
- Non-Collusion Affidavit
- Contract
- Performance Bond
- Labor and Material Payment Bond
- Notice of Intent to Award
- Notice of Award
- Notice to Proceed
- City of Winchester Required General Terms and Conditions
- General Conditions
- Supplement to General Conditions
- Special Terms and Conditions

TECHNICAL SPECIFICATIONS

<u>Division</u>	<u>Section</u>	<u>Title</u>
1		<u>GENERAL REQUIREMENTS</u>
	01010	Summary of Work
	01025	Measurement and Payment
	01070	Abbreviations
	01090	Reference Standards
	01200	Project Meetings
	01300	Submittals
	01400	Quality Control
	01510	Temporary Utilities
	01520	Maintenance of Utility Operations During Construction
	01530	Protection of Existing Facilities
	01540	Demolition and Removal of Existing Structures and Equipment
	01550	Site Access and Storage
	01700	Project Closeout
2		<u>SITework</u>
		Contract - 3

<u>Division</u>	<u>Section</u>	<u>Title</u>
	02200	Earthwork
	02276	Erosion and Sedimentation Control
3		<u>CONCRETE</u>
	03200	Reinforcing Steel
	03300	Cast-in-Place Concrete
5		<u>METALS</u>
	05050	Metal Fastening
15		<u>MECHANICAL</u>
	15480	Generator Fuel System
16		<u>ELECTRICAL</u>
	16000	Basic Electrical Requirements
	16050	Power System Studies
	16111	Conduit
	16118	Underground Electrical
	16123	Low Voltage Wire and Cable
	16130	Boxes
	16170	Grounding and Bonding
	16190	Supporting Devices
	16195	Electrical Identification
	16470	Panelboards
	16620	Packaged Engine Generator Systems
	16902	Electrical Controls and Relays
	16903	Control Panels and Enclosures

DRAWINGS

	Cover
G-1	Index General Notes, Symbols, and Abbreviations
C-1	Existing Conditions and Demolition
C-2	Site Plan and Detail
C-3	Civil and Structural Notes and Details
E-1	Electrical Symbols and Abbreviations
E-2	Electrical Site Plan
E-3	Electrical One-Line Diagram
E-4	Electrical Details
E-5	Pump Station Electrical Power Plan
E-6	Control One-Line Diagrams
E-7	Electrical Schedules

ADDENDA:

<u>NUMBER</u>	<u>DESCRIPTION</u>	<u>DATE</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

Above components are complimentary and what is called for by one shall be binding as if called by all.

IN WITNESS WHEREOF, the parties hereto have hereunto set their hands and seals the date first written above.

CONTRACTOR:

CITY OF WINCHESTER, VIRGINIA:

CITY MANAGER

NAME AND TITLE

ATTEST

ATTEST

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PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____ as Principal, hereinafter

called Contractor, and _____

Surety Company, with General Offices in _____

_____, a corporation organized under the laws of the State of _____ and authorized to transact business in the State of Virginia as Surety, hereinafter called Surety, are held and firmly bound onto the City of Winchester, Virginia, hereinafter called Owner, in the penal sum

_____ (_____)Dollars, lawful money of the United States, for the payment of which sum, will and truly be made, the Said Contractor and Surety bind themselves, their successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and delivered this ____ day of _____, 2018.

WHEREAS, the above named and bounded Contractor has entered into a written contract with the Owner, dated _____, 2018 for:

ITB #201816 – Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

in accordance with the Drawings and Specifications prepared by the Engineering Department, City of Winchester, Virginia, 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 the 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 time made by the Owner.

Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

1. Complete the Contract in accordance with its terms and conditions, or
2. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or, if the Owner elects, upon determination by the Owner and the Surety jointly of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as work progresses (even though there should be a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of contract price," as used in this paragraph, shall mean the total amount payable by the Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

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.

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 _____ 2018.

PRINCIPAL

SURETY

TITLE

TITLE

WITNESS

WITNESS

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____

_____ as Principal, hereinafter

called Contractor, and _____

Surety Company, with General Offices in _____

_____, a corporation organized under the laws of the State of _____ and authorized to transact business in the State of Virginia as Surety, hereinafter called Surety, are held and firmly bound unto the City of Winchester, Virginia, hereinafter called Owner, in the penal sum

_____ (_____)Dollars, lawful money of the United States, for the payment of which sum, will and truly be made, the Said Contractor and Surety bind themselves, their successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and delivered this _____ day of _____ 2018.

WHEREAS, the above named and bounded Contractor has entered into a written contract with the Owner, dated _____, 2018 for:

ITB #201816 – Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

in accordance with the Drawings and Specifications prepared by the Engineering Department, City of Winchester, Virginia, 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 the Contractor shall promptly make payment to 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 full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Principal or with a Subcontractor of the Principal 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 Principal and Surety hereby jointly and severally agree 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 judgement 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 the one having a direct Contract with the Principal, shall have given written notice to any two of the following: the Principal, the Owner, or the Surety above named, within (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 paid, in an envelope addressed to the Principal, 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 Principal ceased work on said Contract, 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, or 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 mechanic's liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

Signed and sealed this _____ day of _____, 2018.

PRINCIPAL

TITLE

WITNESS

SURETY

TITLE

WITNESS

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CITY OF WINCHESTER, VIRGINIA

NOTICE OF INTENT TO AWARD

Date:

To:

Thank you for your proposal concerning our Invitation to Bid For: **Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement**

The City of Winchester intends to award this Invitation to Bid to:

This is not a Notice of Award or a Notice to Proceed.

Sincerely,

Michael Marzullo, CPPB
City of Winchester
Purchasing
Finance Department
15 N. Cameron Street
Winchester, VA 22601
(540) 667-1815 EXT 1477

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NOTICE OF AWARD

DATE:

TO:

**PROJECT TITLE: ITB#201816– Percy D. Miller Water Treatment Plant Raw Water Pump
Station Generator Replacement**

Gentlemen:

Your Bid, dated _____, for the above Project has been considered and you are the apparent successful bidder. You are hereby notified that you have been awarded a Contract for:

The Contract Price of your contract is \$_____.

Three copies each of the proposed Contract between Owner and Contractor and the Contract Documents accompany this Notice of Award.

You must comply with the following conditions precedent within fifteen days of the date of this Notice of Award, that is by _____.

1. You must deliver to the Owner three (3) fully executed counterparts of the Contract between Owner and Contractor including all the Contract Documents. This includes the sets of Plans and Specifications. Each of the Contract Documents must bear your signature on the Index page of the Plans and on the Specification Table of Contents page.
2. You must deliver with the executed Contract, Payment and Performance Bonds, and required Certificates of Insurance. The Certificate of Insurance must identify the above referenced project as the project for which insurance is being provided. *Additionally, it must indicate the City of Winchester as the Certificate Holder, and name the City of Winchester as an additional insured.*

Failure to comply with these conditions within the time specified will entitle Owner to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

After you comply with those conditions, and upon approval of the Contract Security by the Owner, the Owner will return to you one fully signed counterpart of the Contract with the Contract Documents.

City of Winchester, Virginia

By: _____
City Manager

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NOTICE TO PROCEED

DATE:

TO:

Re: City of Winchester, Department of Public Services

PROJECT TITLE: ITB #201816 – Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement

Gentlemen:

In accordance with the Contract between Owner and Contractor, you are notified that the Time for Completion under the above Contract will commence to run on _____, 2018. By that date, you are to start performing your obligations under the Contract Documents. In accordance with the Contract between Owner and Contractor, the Work shall be substantially completed within 270 calendar days which is _____, 2018.

City of Winchester, Virginia

By: _____
City Manager

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CITY OF WINCHESTER

REQUIRED GENERAL TERMS AND CONDITIONS

- A. APPLICABLE LAWS AND COURTS
- B. ANTI-DISCRIMINATION
- C. ETHICS IN PUBLIC CONTRACTING
- E. IMMIGRATION REFORM AND CONTROL ACT OF 1986
- F. DEBARMENT STATUS
- G. ANTITRUST
- H. MANDATORY USE OF CITY FORM AND TERMS AND CONDITIONS
- I. CLARIFICATION OF TERMS
- J. PAYMENT
- K. PRECEDENCE OF TERMS
- L. QUALIFICATIONS OF BIDDERS OR OFFERORS
- M. TESTING AND INSPECTION
- N. ASSIGNMENT OF CONTRACT
- O. SEVERABILITY
- P. CHANGES TO THE CONTRACT
- Q. DEFAULT
- R. TAXES
- S. USE OF BRAND NAMES
- T. TRANSPORTATION AND PACKAGING
- U. INSURANCE
- V. ANNOUNCEMENT OF AWARD
- W. DRUG-FREE WORKPLACE
- X. NONDISCRIMINATION OF CONTRACTORS
- Y. AVAILABILITY OF FUNDS
- Z. LICENSES AND PERMITS
- AZ. TERMINATION
- BZ. HOLD HARMLESS INDEMNIFICATION
- CZ. CONFIDENTIALITY OF PERSONALLY IDENTIFIABLE INFORMATION
- DZ. BID PRICE CURRENCY

These General Terms and Conditions are required for all sealed and unsealed written or verbal solicitations issued by the City of Winchester for procurements that are subject to the Winchester City Code unless changed, deleted or revised by the City Attorney.

- A. **APPLICABLE LAWS AND COURTS:** This solicitation and any resulting contract shall be governed by the laws of the Commonwealth of Virginia. Any dispute arising from the performance or non-performance of this Agreement shall be resolved or otherwise litigated in the Circuit Court for the City of Winchester, Virginia or the Fourth Circuit Federal District Court in Harrisonburg, Virginia. The agency and the contractor are encouraged to resolve any issues in controversy arising from the award of the contract or any contractual dispute following the Winchester City Code, Chapter 21-61. The contractor shall comply with all applicable federal, state and local laws, rules and regulations.
- B. **ANTI-DISCRIMINATION:** By submitting their (bids/proposals), (bidders/offerors) certify to the City of Winchester that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, as well as the Virginia Fair Employment Contracting Act of 1975, as amended, where applicable, the Virginians With Disabilities Act, the Americans With Disabilities Act and § 2.2-4311 of the *Virginia Public Procurement Act (VPPA)*. If the award is made to a faith-based organization, the organization shall not discriminate against any recipient of goods, services, or disbursements made pursuant to the contract on the basis of the recipient's religion, religious belief, refusal to participate in a religious practice, or on the basis of race, age, color, gender or national origin and shall be subject to the same rules as other organizations that contract with public bodies to account for the use of the funds provided; however, if the faith-based organization segregates public funds into separate accounts, only the accounts and programs funded with public funds shall be subject to audit by the public body. (*Code of Virginia*, § 2.2-4343.1E).

In every contract over \$10,000 the provisions in 1. and 2. below apply:

1. During the performance of this contract, the contractor agrees as follows:

- a. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.
 - b. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer.
 - c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting these requirements.
2. The contractor will include the provisions of 1. above in every subcontract or purchase order over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.
- C. **ETHICS IN PUBLIC CONTRACTING:** By submitting their (bids/proposals), (bidders/offerors) certify that their (bids/proposals) are made without collusion or fraud and that they have not offered or received any kickbacks or inducements from any other (bidder/offeror), supplier, manufacturer or subcontractor in connection with their (bid/proposal), and that they have not conferred on any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.
- D. **IMMIGRATION REFORM AND CONTROL ACT OF 1986:** By submitting their (bids/proposals), (bidders/offerors) certify that they do not and will not during the performance of this contract employ illegal alien workers or otherwise violate the provisions of the federal Immigration Reform and Control Act of 1986.
- E. **DEBARMENT STATUS:** By submitting their (bids/proposals), (bidders/offerors) certify that they are not currently debarred by the Federal Government, Commonwealth of Virginia, or by any City, Town or County from submitting bids or proposals on contracts for the type of goods and/or services covered by this solicitation, nor are they an agent of any person or entity that is currently so debarred.
- F. **ANTITRUST:** By entering into a contract, the contractor conveys, sells, assigns, and transfers to the City of Winchester all rights, title and interest in and to all causes of action it may now have or hereafter acquire under the antitrust laws of the United States and the Commonwealth of Virginia, relating to the particular goods or services purchased or acquired by the City of Winchester under said contract.
- H. **MANDATORY USE OF CITY FORM AND TERMS AND CONDITIONS:** Failure to submit a bid/proposal on the official City form provided for that purpose may be a cause for rejection of the bid/proposal. Modification of or additions to the General Terms and Conditions of the solicitation may be cause for rejection of the bid/proposal; however, the City of Winchester reserves the right to decide, on a case by case basis, in its sole discretion, whether to reject such a bid/proposal.
- I. **CLARIFICATION OF TERMS:** If any prospective (bidder/offeror) has questions about the specifications or other solicitation documents, the prospective (bidder/offeror) should contact the buyer whose name appears on the face of the solicitation no later than five working days before the due date. Any revisions to the solicitation will be made only by addendum issued by the Purchasing Agent, or designee.
- J. **PAYMENT:**
1. **To Prime Contractor:**
 - a. Invoices for items ordered, delivered and accepted shall be submitted by the contractor directly to the payment address shown on the purchase order/contract. All invoices shall show the state contract number and/or purchase order number; social security number (for individual contractors) or the federal employer identification number (for proprietorships, partnerships, and corporations).
 - b. Any payment terms requiring payment in less than 30 days will be regarded as requiring payment 30 days after invoice or delivery, whichever occurs last. This shall not affect offers of discounts for payment in less than 30 days, however.

- c. All goods or services provided under this contract or purchase order, that are to be paid for with public funds, shall be billed by the contractor at the contract price, regardless of which department is being billed.
- d. The following shall be deemed to be the date of payment: the date of postmark in all cases where payment is made by mail.
- e. **Unreasonable Charges.** Under certain emergency procurements and for most time and material purchases, final job costs cannot be accurately determined at the time orders are placed. In such cases, contractors should be put on notice that final payment in full is contingent on a determination of reasonableness with respect to all invoiced charges. Charges which appear to be unreasonable will be researched and challenged, and that portion of the invoice held in abeyance until a settlement can be reached. Upon determining that invoiced charges are not reasonable, the City of Winchester shall promptly notify the contractor, in writing, as to those charges which it considers unreasonable and the basis for the determination. A contractor may not institute legal action unless a settlement cannot be reached within thirty (30) days of notification. The provisions of this section do not relieve an agency of its prompt payment obligations with respect to those charges which are not in dispute (*Code of Virginia, § 2.2-4363*).

2. To Subcontractors:

- a. A contractor awarded a contract under this solicitation is hereby obligated:
 - (1) To pay the subcontractor(s) within seven (7) days of the contractor's receipt of payment from the City of Winchester for the proportionate share of the payment received for work performed by the subcontractor(s) under the contract; or
 - (2) To notify the agency and the subcontractor(s), in writing, of the contractor's intention to withhold payment and the reason.
- b. The contractor is obligated to pay the subcontractor(s) interest at the rate of one percent per month (unless otherwise provided under the terms of the contract) on all amounts owed by the contractor that remain unpaid seven (7) days following receipt of payment from the City of Winchester, except for amounts withheld as stated in (2) above. The date of mailing of any payment by U. S. Mail is deemed to be payment to the addressee. These provisions apply to each sub-tier contractor performing under the primary contract. A contractor's obligation to pay an interest charge to a subcontractor may not be construed to be an obligation of the City of Winchester.

K. **PRECEDENCE OF TERMS:** The following General Terms and Conditions APPLICABLE LAWS AND COURTS, ANTI-DISCRIMINATION, ETHICS IN PUBLIC CONTRACTING, IMMIGRATION REFORM AND CONTROL ACT OF 1986, DEBARMENT STATUS, ANTITRUST, MANDATORY USE OF CITY FORM AND TERMS AND CONDITIONS, CLARIFICATION OF TERMS, PAYMENT shall apply in all instances. In the event there is a conflict between any of the other General Terms and Conditions and any Special Terms and Conditions in this solicitation, the Special Terms and Conditions shall apply and take precedence.

The City's procurement, Contractor's response and written negotiation summary shall form part of the Contract. In the case of conflicts, discrepancies, errors or omissions among the City's procurement, the Contractor's response, written negotiation summary and the main body of the Contract, the documents and amendments to them shall take precedence and govern in the following order:

1. Contract
2. Negotiation Summary
3. City's Procurement Document(s)
4. Contractor's Response
5. Other Documents

L. **QUALIFICATIONS OF (BIDDERS/OFFERORS):** The City of Winchester may make such reasonable investigations as deemed proper and necessary to determine the ability of the (bidder/offeror) to perform the services/furnish the goods and the (bidder/offeror) shall furnish to the City of Winchester all such information and data for this purpose as may be requested. The City of Winchester reserves the right to inspect (bidder's/offeror's) physical facilities prior to award to satisfy questions regarding the (bidder's/offeror's) capabilities. The City of Winchester further reserves the right to reject any (bid/proposal) if the evidence submitted by, or investigations of, such (bidder/offeror) fails to satisfy the City of Winchester that such (bidder/offeror) is properly qualified to carry out the obligations of the contract and to provide the services and/or furnish the goods contemplated therein.

- M. **TESTING AND INSPECTION:** The City of Winchester reserves the right to conduct any test/inspection it may deem advisable to assure goods and services conform to the specifications.
- N. **ASSIGNMENT OF CONTRACT:** A contract shall not be assignable by the contractor in whole or in part without the written consent of the City of Winchester.
- O. **SEVERABILITY OF CONTRACT:** In the event that any provision shall be adjudged or decreed to be invalid, such ruling shall not invalidate the entire Agreement but shall pertain only to the provision in question and the remaining provisions shall continue to be valid, binding and in full force and effect.
- P. **CHANGES TO THE CONTRACT:**
1. A public contract may include provisions for modification of the contract during performance, but no fixed-price contract may be increased by more than twenty-five percent of the amount of the contract or ten thousand dollars (\$10,000), whichever is greater, without the advance written approval of the City Council. In no event may the amount of any contract, without adequate consideration, be increased for any purpose, including, but not limited to, relief of an offeror from the consequences of an error in its bid or offer (Winchester City Code 21-44).
 2. Changes can be made to the contract in any of the following ways:
 - a. The parties may agree in writing to modify the scope of the contract. An increase or decrease in the price of the contract resulting from such modification shall be agreed to by the parties as a part of their written agreement to modify the scope of the contract.
 - b. The City of Winchester may order changes within the general scope of the contract at any time by written notice to the contractor. Changes within the scope of the contract include, but are not limited to, things such as services to be performed, the method of packing or shipment, and the place of delivery or installation. The contractor shall comply with the notice upon receipt. The contractor shall be compensated for any additional costs incurred as the result of such order and shall give the City of Winchester a credit for any savings. Said compensation shall be determined by one of the following methods:
 1. By mutual agreement between the parties in writing; or
 2. By agreeing upon a unit price or using a unit price set forth in the contract, if the work to be done can be expressed in units, and the contractor accounts for the number of units of work performed, subject to the City of Winchester's right to audit the contractor's records and/or to determine the correct number of units independently; or
 3. By ordering the contractor to proceed with the work and keep a record of all costs incurred and savings realized. A markup for overhead and profit may be allowed if provided by the contract. The same markup shall be used for determining a decrease in price as the result of savings realized. The contractor shall present the City of Winchester with all vouchers and records of expenses incurred and savings realized. The City of Winchester shall have the right to audit the records of the contractor as it deems necessary to determine costs or savings. Any claim for an adjustment in price under this provision must be asserted by written notice to the City of Winchester within thirty (30) days from the date of receipt of the written order from the City of Winchester. If the parties fail to agree on an amount of adjustment, the question of an increase or decrease in the contract price or time for performance shall be resolved in accordance with the procedures for resolving disputes provided by the Disputes Clause of this contract or, if there is none, in accordance with the disputes provisions of the City of Winchester Code. Neither the existence of a claim nor a dispute resolution process, litigation or any other provision of this contract shall excuse the contractor from promptly complying with the changes ordered by the City of Winchester or with the performance of the contract generally.
- Q. **DEFAULT:** In case of failure to deliver goods or services in accordance with the contract terms and conditions, the City of Winchester, after due oral or written notice, may procure them from other sources and hold the contractor responsible for any resulting additional purchase and administrative costs. This remedy shall be in addition to any other remedies which the City of Winchester may have.
- R. **TAXES:** Sales to the City of Winchester are normally exempt from State sales tax. State sales and use tax certificates of exemption, Form ST-12, will be issued upon request.

- S. **USE OF BRAND NAMES:** Unless otherwise provided in this solicitation, the name of a certain brand, make or manufacturer does not restrict (bidders/offerors) to the specific brand, make or manufacturer named, but conveys the general style, type, character, and quality of the article desired. Any article which the public body, in its sole discretion, determines to be the equal of that specified, considering quality, workmanship, economy of operation, and suitability for the purpose intended, shall be accepted. The (bidder/offeror) is responsible to clearly and specifically identify the product being offered and to provide sufficient descriptive literature, catalog cuts and technical detail to enable the City of Winchester to determine if the product offered meets the requirements of the solicitation. This is required even if offering the exact brand, make or manufacturer specified. Normally in competitive sealed bidding only the information furnished with the bid will be considered in the evaluation. Failure to furnish adequate data for evaluation purposes may result in declaring a bid nonresponsive. Unless the (bidder/offeror) clearly indicates in its (bid/proposal) that the product offered is an equal product, such (bid/proposal) will be considered to offer the brand name product referenced in the solicitation.
- T. **TRANSPORTATION AND PACKAGING:** By submitting their (bids/proposals), all (bidders/offerors) certify and warrant that the price offered for FOB destination includes only the actual freight rate costs at the lowest and best rate and is based upon the actual weight of the goods to be shipped. Except as otherwise specified herein, standard commercial packaging, packing and shipping containers shall be used. All shipping containers shall be legibly marked or labeled on the outside with purchase order number, commodity description, and quantity.
- U. **INSURANCE:** By signing and submitting a bid or proposal under this solicitation, the bidder or offeror certifies that if awarded the contract, it will have the following insurance coverage at the time the contract is awarded. For construction contracts, if any subcontractors are involved, the subcontractor will have workers' compensation insurance in accordance with §§ 2.2-4332 and 65.2-800 et seq. of the *Code of Virginia*. The bidder or offeror further certifies that the contractor and any subcontractors will maintain these insurance coverage during the entire term of the contract and that all insurance coverage will be provided by insurance companies authorized to sell insurance in Virginia by the Virginia State Corporation Commission.

MINIMUM INSURANCE COVERAGES AND LIMITS REQUIRED FOR MOST CONTRACTS:

1. Workers' Compensation - Statutory requirements and benefits. Coverage is compulsory for employers of three or more employees, to include the employer. Contractors who fail to notify the City of Winchester of increases in the number of employees that change their workers' compensation requirements under the *Code of Virginia* during the course of the contract shall be in noncompliance with the contract. The insurer must have an A.M. Best rating of A- or better.
2. Employer's Liability - \$100,000.
3. Commercial General Liability - \$1,000,000 per occurrence. Commercial General Liability is to include bodily injury and property damage, personal injury and advertising injury, products and completed operations coverage. The City of Winchester must be named as an additional insured and so endorsed on the policy by the insurer. A notation on the certificate of insurance is not sufficient.
4. Automobile Liability - \$1,000,000 per occurrence. (Only used if motor vehicle is to be used in the contract.)

NOTE: In addition, various Professional Liability/Errors and Omissions coverages are required when soliciting those services as follows:

<u>Profession/Service</u>	<u>Limits</u>
Accounting	\$1,000,000 per occurrence, \$3,000,000 aggregate
Architecture	\$2,000,000 per occurrence, \$6,000,000 aggregate
Asbestos Design, Inspection or Abatement Contractors	\$1,000,000 per occurrence, \$3,000,000 aggregate
Health Care Practitioner (to include Dentists, Licensed Dental Hygienists, Optometrists, Registered or Licensed Practical Nurses, Pharmacists, Physicians, Podiatrists, Chiropractors, Physical Therapists, Physical Therapist Assistants, Clinical Psychologists, Clinical Social Workers, Professional Counselors, Hospitals, or Health Maintenance Organizations.)	\$1,925,000 per occurrence, \$3,000,000 aggregate
(Limits increase each July 1 through fiscal year 2008, as follows:	

July 1, 2008 - \$2,000,000. This complies with §8.01-581.15 of the *Code of Virginia*.

Insurance/Risk Management	\$1,000,000 per occurrence, \$3,000,000 aggregate
Landscape/Architecture	\$1,000,000 per occurrence, \$1,000,000 aggregate
Legal	\$1,000,000 per occurrence, \$5,000,000 aggregate
Professional Engineer	\$2,000,000 per occurrence, \$6,000,000 aggregate
Surveying	\$1,000,000 per occurrence, \$1,000,000 aggregate

V. **ANNOUNCEMENT OF AWARD:** Upon the award or the announcement of the decision to award a contract over \$50,000, as a result of this solicitation, the Purchasing Agent will publicly post such notice on the City of Winchester's web site (www.winchesterva.gov/purchasing) for a minimum of 10 days.

W. **DRUG-FREE WORKPLACE:** During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this section, "*drug-free workplace*" means a site for the performance of work done in connection with a specific contract awarded to a contractor, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

X. **NONDISCRIMINATION OF CONTRACTORS:** A bidder, offeror, or contractor shall not be discriminated against in the solicitation or award of this contract because of race, religion, color, sex, national origin, age, disability, faith-based organizational status, any other basis prohibited by state law relating to discrimination in employment or because the bidder or offeror employs ex-offenders unless the state agency, department or institution has made a written determination that employing ex-offenders on the specific contract is not in its best interest. If the award of this contract is made to a faith-based organization and an individual, who applies for or receives goods, services, or disbursements provided pursuant to this contract objects to the religious character of the faith-based organization from which the individual receives or would receive the goods, services, or disbursements, the public body shall offer the individual, within a reasonable period of time after the date of his objection, access to equivalent goods, services, or disbursements from an alternative provider.

Y. **AVAILABILITY OF FUNDS:** In the event that funds are not appropriated for this Contract for any City fiscal year, following the City's current year, the Contract shall terminate automatically as of the last day for which funds were appropriated without the City providing written notice to the Contractor prior to the date of termination. The City shall not consider termination of the Contract pursuant to this section default. Upon such termination, the City shall be released from any obligation to make future payments and shall not be liable for cancellation or termination charges.

Z. **LICENSES AND PERMITS:** Contractors will be responsible for all licenses and permits, if required. Any person, firm, or corporation responding to the City's procurement which is required to have a current and valid City of Winchester business license and, in fact, does not, will not be considered a "responsive bidder" as such term is defined by the Code of Virginia §2.2-4301, as amended. Any bid received from such an entity may be rejected, at the City's sole option, for that reason alone. In addition, the successful bidder or offeror will be required to produce affirmative evidence, satisfactory to the Purchasing Agent, or designee that it has such a license, or is not required to have such a license, prior to approval and execution of any contract to perform the work herein described.

AZ **TERMINATION:**

a. Termination for Convenience: The City of Winchester may terminate a contract, in whole or in part, whenever the City OF Winchester determines that such termination is in the best interest of the City of Winchester, without showing cause, upon giving ten (10) days written notice to the vendor.

b. Termination for Default: When the vendor has not performed or has unsatisfactorily performed the contract, the City of Winchester may terminate the contract for default. Upon termination for default, payment may be withheld at the discretion of the City of Winchester. The Vendor will be paid for work satisfactorily performed prior to termination.

- BZ. **HOLD HARMLESS:** Bids/Proposal shall provide that during the term of the contract, including warranty period, for the successful bidder/offeror indemnifying, defending, and holding harmless the City, its officers, employees, agent and representatives thereof from all suits, actions, claims of any kind (including claims for attorney's fees) brought on account of any personal injuries, damages, or violation of rights sustained by any person or property in consequence of any neglect in safeguarding contract work, or on account of any act or omission by the contractor or his employees, or from any claims or amounts arising from violation of any law, bylaw, ordinance, regulation or decree. The vendor agrees that this clause shall include claims involving infringement of patent or copyrights.
- CZ. **CONFIDENTIALITY OF PERSONALLY IDENTIFIABLE INFORMATION:** The contractor assures that information and data obtained as to personal facts and circumstances related to patients or clients will be collected and held confidential, during and following the term of this agreement, and will not be divulged without the individual's and the agency's written consent and only in accordance with federal law or the Code of Virginia. Contractors who utilize, access, or store personally identifiable information as part of the performance of a contract are required to safeguard this information and immediately notify the agency of any breach or suspected breach in the security of such information. Contractors shall allow the City to both participate in the investigation of incidents and exercise control over decisions regarding external reporting. Contractors and their employees working on this project may be required to sign a confidentiality statement.
- DZ. **BID PRICE CURRENCY:** Prices are to be stated in US dollars unless otherwise specified in the solicitation.

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By



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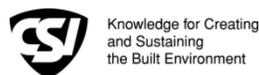
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These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

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

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

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

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

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

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

8. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of

acceptable form, if any, and the Bid Form with any supplements.

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

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

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

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

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

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

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

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

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and

other Contractor submittals are not Drawings as so defined.

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

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

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

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

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

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

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

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

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

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

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

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

30. *PCBs*--Polychlorinated biphenyls.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

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

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

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

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

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

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

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

1.02 *Terminology*

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

B. *Intent of Certain Terms or Adjectives*

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

C. *Day*

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

D. *Defective*

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

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

E. *Furnish, Install, Perform, Provide*

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

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

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

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

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

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

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

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

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project

Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

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

2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

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

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

2. a preliminary Schedule of Submittals; and

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

2.06 *Preconstruction Conference*

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

submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

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

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

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

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

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

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

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

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

3.02 Reference Standards

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

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

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

3.03 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

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

2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor

shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

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

B. Resolving Discrepancies

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

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

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

3.04 Amending and Supplementing Contract Documents

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

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

1. A Field Order;

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

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

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

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

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

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

3.06 *Electronic Data*

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

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

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

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

4.01 *Availability of Lands*

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

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

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

4.02 *Subsurface and Physical Conditions*

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

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

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

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not

Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

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

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

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

4.03 Differing Subsurface or Physical Conditions

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

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

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

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

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

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

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

C. Possible Price and Times Adjustments

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

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

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

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

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

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

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

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but

not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

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

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

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

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

B. *Not Shown or Indicated*

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

ground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

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

4.05 *Reference Points*

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

4.06 *Hazardous Environmental Condition at Site*

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

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

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

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

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

5.02 *Licensed Sureties and Insurers*

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

5.03 *Certificates of Insurance*

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

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

5.04 *Contractor's Liability Insurance*

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

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

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

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

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

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

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible

property wherever located, including loss of use resulting therefrom; and

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

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

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

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

3. include completed operations insurance;

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

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

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

7. with respect to completed operations insurance, and any insurance coverage written on a claims-

made basis, remain in effect for at least two years after final payment.

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

5.05 *Owner's Liability Insurance*

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

5.06 *Property Insurance*

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

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

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

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

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

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

6. include testing and startup; and

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

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

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

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.06, Owner shall, if

possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 Waiver of Rights

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

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

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

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project

or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

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

5.08 *Receipt and Application of Insurance Proceeds*

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

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

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

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect

of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

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

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

received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

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

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

6.03 *Services, Materials, and Equipment*

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

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

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

6.04 *Progress Schedule*

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

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

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

6.05 *Substitutes and "Or-Equals"*

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

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

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

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

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

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

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

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

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

2. Substitute Items

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

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

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

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

1) shall certify that the proposed substitute item will:

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

b) be similar in substance to that specified, and

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

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will pre-

dice Contractor's achievement of Substantial Completion on time;

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

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

3) will identify:

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

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

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

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

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

advise Contractor in writing of any negative determination.

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

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

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

6.06 *Concerning Subcontractors, Suppliers, and Others*

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

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

any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

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

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

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

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

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

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

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer,, and all other

individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

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

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

6.08 *Permits*

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

6.09 *Laws and Regulations*

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

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

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

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas

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

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

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

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

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

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

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

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

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

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

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

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

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

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

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

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

1. Shop Drawings

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

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

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

a. Submit number of Samples specified in the Specifications.

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

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

C. Submittal Procedures

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

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

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

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and

safety precautions and programs incident thereto;
and

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

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

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

D. Engineer's Review

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

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

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written

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

E. Resubmittal Procedures

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

6.18 Continuing the Work

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

6.19 Contractor's General Warranty and Guarantee

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

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

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

2. normal wear and tear under normal usage.

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

1. observations by Engineer;

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

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

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

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

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

7. any correction of defective Work by Owner.

6.20 Indemnification

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

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

acts, disability benefit acts, or other employee benefit acts.

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

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

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

6.21 Delegation of Professional Design Services

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

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

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

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria

given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

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

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

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

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

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

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

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by

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

7.02 *Coordination*

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

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

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

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

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

7.03 *Legal Relationships*

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

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

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

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *Pay When Due*

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

8.05 *Lands and Easements; Reports and Tests*

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

8.06 *Insurance*

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

8.07 *Change Orders*

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

8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

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

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

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

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on

information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

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

9.03 *Project Representative*

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

9.04 *Authorized Variations in Work*

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

, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

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

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

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

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

9.07 *Determinations for Unit Price Work*

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

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

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the

requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

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

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

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

9.09 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

D. Engineer's review of the final Application for Payment and accompanying documentation and all

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

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

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

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

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

10.02 *Unauthorized Changes in the Work*

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

10.03 *Execution of Change Orders*

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

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph

13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

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

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

10.04 Notification to Surety

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

10.05 Claims

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

B. *Notice:* Written notice stating the general nature of each Claim, shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract

Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

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

1. deny the Claim in whole or in part,
2. approve the Claim, or

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

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

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

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

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

11.01 Cost of the Work

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional

or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

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

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

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

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories,

surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

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

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

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

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

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

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

losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

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

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

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

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

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

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

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

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

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

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

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

11.02 Allowances

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

B. Cash Allowances

1. Contractor agrees that:

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

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

C. Contingency Allowance

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

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

11.03 *Unit Price Work*

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

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

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

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

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

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

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

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

12.01 *Change of Contract Price*

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

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

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

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

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

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

1. a mutually acceptable fixed fee; or

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

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

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

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

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

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

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

12.02 *Change of Contract Times*

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

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

12.03 *Delays*

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

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

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

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

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

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

13.01 *Notice of Defects*

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

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

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

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

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

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

3. as otherwise specifically provided in the Contract Documents.

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

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

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

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

13.04 *Uncovering Work*

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

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

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

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

13.05 *Owner May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

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

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

13.07 *Correction Period*

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

1. repair such defective land or areas; or
2. correct such defective Work; or
3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

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

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

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

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

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

13.08 *Acceptance of Defective Work*

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

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective

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

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

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

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

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

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

14.02 *Progress Payments*

A. Applications for Payments

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

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

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

B. *Review of Applications*

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

make the necessary corrections and resubmit the Application.

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

- a. the Work has progressed to the point indicated;
- b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and
- c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

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

- a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
- b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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

- a. to supervise, direct, or control the Work, or
- b. for the means, methods, techniques, sequences, or procedures of construction, or the

safety precautions and programs incident thereto, or

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

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

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

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

- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
- b. the Contract Price has been reduced by Change Orders;
- c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
- d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due

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

D. Reduction in Payment

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

- a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
- b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
- c. there are other items entitling Owner to a set-off against the amount recommended; or
- d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

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

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

14.03 *Contractor's Warranty of Title*

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

14.04 *Substantial Completion*

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

B. Promptly after Contractor's notification, , Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work

substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

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

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

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

14.05 *Partial Utilization*

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

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

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

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

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

14.06 Final Inspection

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

14.07 Final Payment

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of

inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

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

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

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

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

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

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

B. Engineer's Review of Application and Acceptance

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

return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

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

14.08 *Final Completion Delayed*

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

14.09 *Waiver of Claims*

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

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

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

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

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

15.02 *Owner May Terminate for Cause*

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

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

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

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

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

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

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the

Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),

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

3. complete the Work as Owner may deem expedient.

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

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

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

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

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner,

terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

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

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

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

4. reasonable expenses directly attributable to termination.

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

15.04 *Contractor May Stop Work or Terminate*

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

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a

Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

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

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

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

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or
2. agrees with the other party to submit the Claim to another dispute resolution process, or
3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

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

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

17.02 *Computation of Times*

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

17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

1. Delete subparagraph 5.06(A), 5.06(A) Sections 1-7, and subparagraph 5.06(B)
2. Delete sentence in subparagraph 5.07(A) beginning with “All such projects shall contain provisions....”
3. Delete subparagraph 5.07(B), 5.06(B) Sections 1-2, and subparagraph 5.06(C)
4. Delete Paragraph 10.05 (Claims) and replace Paragraph 10.05 (Claims) by reference with the Winchester City Code, Section 21-61 (Contractual Disputes), as amended and where the Winchester City Code does not specify in writing the Virginia Public Procurement Act (VPPA) §2.2-4363 shall apply, as amended. Under Winchester City Code 21-61(C), the Purchasing Agent will render such decision within thirty (30) days.
5. Add subparagraph 12.01(D), as follows:
“In accordance with Winchester City Code, Section 21-44, Contract Modification: A public contract may include provisions for modification of the contract during performance, but no fixed-price contract may be increased by more than twenty-five percent of the amount of the contract or ten thousand dollars (\$10,000), whichever is greater, without the advance written approval of the City Council. In no event may the amount of any contract, without adequate consideration, be increased for any purpose, including, but not limited to, relief of an offeror from the consequences of an error in its bid or offer.”
6. Add the following language to 14.02 (A3), as follows: “See Special Conditions, Section 4.02.”
7. Delete paragraph 14.09
8. Add subparagraph 17.01 (B), as follows: “This section, or any other General Condition in conflict with Virginia Code §8.01-222 shall not supercede the Commonwealth of Virginia statutory notice provisions. Virginia Code §8.01-222 shall prevail under all circumstances.

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**ITB #201816– Percy D. Miller Water Treatment Plant Raw Water Pump Station
Generator Replacement**

SPECIAL CONDITIONS

1. SPECIFICATIONS

Unless otherwise described in the Contract Documents, the following specifications and standards apply to this work:

1. National Electrical Code (latest edition)
2. City of Winchester – Public Services Standards Manual

2. INSURANCE REQUIREMENTS – CITY OF WINCHESTER

2.01 Before any work at the site is started, Contractor shall deliver to Owner, with a Copy to Engineer, an executed Certificate of Insurance. The Certificate shall indicate that the required insurance is in force and state that the policies will not be materially changed or canceled without a thirty (30) day advance notice by registered mail to Owner and Engineer. The representative signing the Certificate shall furnish evidence that he is authorized to so sign as well as his address and the name and address of the agency or agencies through which the insurance was obtained. Contractor shall take out and maintain the following insurance:

2.02 Contractor's Comprehensive General Liability (bodily injury and property damage) shall be provided for the following limits:

- A. Combined single limit 5,000,000 dollars each occurrence
- B. Combined single limit: 5,000,000 dollars annual aggregate
- C. The general liability insurance shall include the following coverage:

1. Comprehensive Form
2. Premises - Operation
3. Explosion and Collapse Hazard
4. Underground Hazards
5. Products/Completed - Operations Hazards
6. Contractual Liability Insurance
7. Broad Form Comprehensive General Liability, Property Damage, including Completed Operations
8. Independent Contractors (Contractor's Protective Liability)
9. Personal Injury (all insuring agreements), Deleting the Employee Exclusion
10. If protection is under an umbrella policy, it shall not exclude any of the above items under the basic policy.

D. City of Winchester shall be named by endorsement as Additional Insured.

- 2.03 Contractor's Automobile Liability (bodily injury and property damage) shall be provided for the following limits:
- A. Combined single limit: 1,000,000 dollars each occurrence
 - B. The Automobile Liability Insurance shall include the following coverage:
 - 1. Comprehensive Form
 - 2. Owned
 - 3. Hired
 - 4. Non-Owner
- 2.04 Contractor's Workers Compensation Insurance as required by Federal, State, and Municipal Laws for the protection of all Contractor's employees working on or in connection with the Project, including broad form, all state and voluntary compensation coverage, and employer's liability coverage with the following limits:
- A. Bodily injury by accident 1,000,000 Dollars each accident
 - B. Bodily injury by disease 1,000,000 Dollars policy limit
 - C. Bodily injury by disease 1,000,000 Dollars for each employee
- 2.05 All insurers shall be licensed to conduct business in the Commonwealth of Virginia and all insurance companies are required to have an A.M. Best Company financial rating of A- or better.
- 2.06 Contractor shall require his insurance agent to certify on the insurance certificate that the insurance coverage specified by these specifications is fully in effect, both in scope and amount. If insurance coverage is effected with more than one company, the individual certificates shall identify the items of insurance which the individual companies cover. The insurance certificates shall contain a provision that the coverage afforded under the policies will not be canceled or materially changed unless at least a thirty (30) days prior written notice has been given to the Owner.
- 2.07 Left Intentionally Blank
- 2.08 Notification and Handling of an Insurance Claim:
The general contractor on any City construction project shall be responsible for ensuring that all matters concerning the completion of an assigned project, including but not limited to handling of insurance claims by third parties arising as a result of the acts and omissions of the general contractor or his subcontractors, are handled in a professional manner. To this end, the City expects the general contractor to act responsibly with regard to prompt payment of valid insurance claims and upon notice of a claim, the general contractor shall immediately notify the Owner's project manager, investigate and document the claim, and make a liability determination within ten (10) business days. Pending subrogation between the general contractor and/or sub-contractor and/or any insurance carrier will not be a cause for delay in payment of a valid claim. Default of this provision may result in retainage payments

being withheld and jeopardize the general contractor's future bid opportunities with the City of Winchester.

3. **WORKING HOURS - HOLIDAYS**

Work under the Contract shall not be prosecuted on Sundays, or on legal holidays. Work hours (Monday – Saturday) shall be from 7:00 a.m. until 6:00 p.m. If the Contractor wishes to prosecute any portion of the Work outside of the established work hours or on Sundays or legal holidays, he shall first obtain written permission from the Engineer. Such requests shall be submitted at least 48 hours in advance of the period proposed for such overtime work. For the purpose of this Contract, the legal holidays are identified as:

- Memorial Day (May 28, 2018)
- Independence Day (July 4, 2018)
- Labor Day (September 3, 2018)
- Veteran's Day (November 11, 2018)
- Thanksgiving Day (November 22, 2018)
- Day after Thanksgiving (November 23, 2018)
- Christmas Eve observed (December 21, 2018)
- Christmas Day (December 25, 2018)
- New Year's Day (January 1, 2019)

4. **PROGRESS PAYMENTS**

4.01 The basis for payments shall be the actual quantity of work completed, as determined in field by the Engineer.

4.02 An amount equal to five percent (5%) of each progress payment shall be held from each payment as retainage.

5. **MISCELLANEOUS OTHER CONDITIONS**

5.01 It shall be the responsibility of the Contractor to locate utilities in the field. Contractor shall give all utility companies that may have subsurface or surface utilities in the area adequate notice at least 48 hours in advance that the Contractor is to perform work in this area.

5.02 The attention of the Contractor is drawn to the fact that the possibility exists of the Contractor encountering various water, chemical, electrical, or other lines. Contractor shall exercise extreme care before and during construction to locate and flag these items so as to avoid damage to existing lines. Should damage occur to an existing line, the Contractor shall repair the line at no cost to the Owner. Temporary support, adequate protection and maintenance of all underground and surface utility installations and structures, drains, and other obstructions encountered in the progress

of the work shall be provided by the Contractor at his own expense.

- 5.03 Contractor shall be responsible for the temporary removal and re-installation of structures including, but not limited, to piping, conduits, drains, that may interfere with the work. The cost of such work shall be included in the Bid for the project and shall not result in any additional cost to the Owner. It shall be the Contractor's responsibility to contact and obtain permission from various authorities having jurisdiction over such structures, prior to start of the work.
- 5.04 Local drainage is not to be blocked. Shoulders, ditches, and drainage facilities shall be kept clear at all times and in condition satisfactory to the Engineer.
- 5.05 Adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the course of the work, and until it is safe for the pedestrian and vehicular traffic to use the area. The rules and regulations of the Local and State and Federal authorities respecting safety provisions shall be observed.
- 5.06 All acceptance and payment of work is subject to inspection by the City of Winchester.
- 5.07 The Contractor shall be responsible to establish and maintain communications with the residents and business owners of the area affected by the construction. The purpose of this communication is to notify the residents and business owners of construction activities which affect them, and to coordinate accommodations for them during construction. The Contractor shall also be required to assist businesses and residents as necessary with access into or out of their property during the construction.
- 5.08 Contractor and all sub-contractors shall obtain a City of Winchester Business License before beginning work.
- 5.09 Contractor is responsible for correcting any damages caused to private property as a result of construction, at their own expense. Contractor shall be responsible for completing a video recording (DVD) of the entire project area within the City's right-of-way before construction begins and providing a copy of the DVD to the City. This recording must be completed before the mobilization fee is paid to the contractor. This recording will be the basis for help in determining any damages to private property that may occur during construction that the contractor may be responsible for.
- 5.10 The Contractor shall be solely responsible for adhering to all OSHA requirements at all times during the construction of the project.
- 5.11 The Contractor shall be solely responsible for protecting the newly poured sidewalks from vandalism (i.e. children writing names or words in the wet concrete) and shall be required to replace any concrete that is vandalized as directed by the City at the

Contractor's expense.

- 5.12 The Contractor shall be responsible to construct the new facilities and/or modify existing facilities to ensure positive drainage at all locations.
- 5.13 High-early strength concrete shall be used on all driveway entrances.
- 5.14 The Contractor shall be solely responsible for ensuring that all new sidewalks and ramps constructed meet all current ADA (American's with Disabilities Act) requirements.

*****END SPECIAL CONDITIONS*****

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SECTION 01010
SUMMARY OF WORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Work to be done under these Contracts and in accordance with these Specifications consists of furnishing all equipment, superintendence, labor, skill, material and all other Items necessary for the construction of the **Percy D. Miller Water Treatment Plant Raw Water Pump Station Generator Replacement.**

The Contractor shall perform all work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.

- B. The principal features of the Work to be performed under these Contracts includes but is not limited to: **the replacement of an existing 750 kW standby generator with a new 1000 kW Generator, removal of existing 2500 gallon buried fuel oil tank, construction of new 6000 gallon above ground dual wall steel fuel oil tank, addition of fuel monitoring and treatment equipment, new power and control connections to existing electrical distribution equipment, generator lighting, equipment pads, and site restoration.**

1.02 CONSTRUCTION PERMITS

- A. The Contractor shall obtain, keep current and pay all fees for any necessary construction permits from those authorities, agencies, or municipalities having jurisdiction over land areas, utilities, or structures which are located within the Contract limits and which will be occupied, encountered, used, or temporarily interrupted by the Contractor's operations unless otherwise stated. Record copies of all permits shall be furnished to the Engineer.
- B. When construction permits are accompanied by regulations or requirements issued by a particular authority, agency or municipality, it shall be the Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this Project.

1.03 ADDITIONAL ENGINEERING SERVICES

- A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

- B. Structural design shown on the Contract Drawings is based upon typical weights for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished exceeds the weights of said equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith.
- C. In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

1.04 FIRST AID FACILITIES AND ACCIDENTS

A. First Aid Facilities

- 1. The Contractor shall provide at the site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the work.

B. Accidents

- 1. The Contractor shall promptly report, in writing, to the Engineer and Owner all accidents whatsoever out of, or in connection with, the performance of the work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.
- 2. If death, serious injuries, or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Owner and the Engineer.
- 3. If any claim is made by anyone against the Contractor or a Subcontractor on account of any accidents, the Contractor shall promptly report the facts, in writing, to the Engineer and Owner, giving full details of the claim.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Items listed in this Section, beginning with Article 1.4, refer to and are the same pay items listed in the Bid Form. They constitute all pay items for completing the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant services, field offices, layout surveys, Project signs, sanitary requirements, testing, safety devices, submittals and record drawings, water supplies, power and fuel, traffic maintenance, removal of waste, security, coordination with OWNER's operations, bonds, insurance, or all other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents. Compensation for all services, items, and products shall be included in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.
- B. Each lump sum and unit bid price shall be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

1.02 ENGINEER'S ESTIMATE OF QUANTITIES

- A. ENGINEER's estimated quantities for unit price items, as listed in the Bid Form, are approximate only and are included solely for the purpose of comparing Bids. OWNER does not expressly or by implication agree that the nature of materials encountered below ground surface or actual quantities of material encountered or required shall correspond with quantities on the Bid Form, and reserves the right to increase or decrease quantities or to eliminate quantities as OWNER may deem necessary. CONTRACTOR shall not be entitled to adjustment in a unit bid price as a result of change in an estimated quantity and agrees to accept the unit prices bid as complete and total compensation for additions or deductions caused by changes or alterations in the Work directed by OWNER.

1.03 RELATED PROVISIONS

- A. Payments to CONTRACTOR: Refer to General Conditions, Supplementary Conditions, and Agreement.
- B. Changes in Contract Price: Refer to General Conditions and Supplementary Conditions.
- C. Schedule of Values: Refer to General Conditions, Supplementary Conditions.

1.04 BID ITEMS

- A. Item 1 – For Contract Work:
 - 1. Measurement and Payment: The Lump Sum payment for Item 1 will be full compensation for completing the Work, as shown and specified in the Contract

Documents and as summarized in Section 01110 – Summary of Work, including but not limited to all excavation of both soil and rock required to meet grades as shown on the Drawings, haul-off, disposal, demolition and temporary facilities, with the exception of the additional work items that CONTRACTOR may be ordered by ENGINEER to perform which are as listed in Items 2& 3 below.

B. Item 2 – Additional Excavation

1. Measurement: The quantity of additional excavation including disposal of unsuitable materials will be measured for payment on the basis of lines and grades ordered by ENGINEER in writing, or as volume within limits described below, whichever is applicable.
 - a. Excavation as required for structures or facilities will be measured for payment to subgrade directed for such excavation and, unless otherwise shown, to vertical planes one foot outside foundation limits of structure to be built therein.
 - b. Measurement of actual quantities will be made by ENGINEER. CONTRACTOR may, at his expense, verify quantities.
2. Payment: Unit price for Item 2 will be full compensation for all additional excavation, including disposal, complete as directed by ENGINEER and not specifically included under other items.

C. Item 3 - Additional Backfill with VDOT 21A Stone

1. Measurement: The quantity of additional crushed stone consisting of VDOT No. 21A Stone that will be paid under this item will be the computed number of cubic yards placed and compacted within limits shown, specified or directed by ENGINEER in writing.
2. Payment: Unit price for Item 3 will be full compensation for providing, placing, compacting, and testing all additional crushed stone or gravel complete as shown, specified, or directed by ENGINEER in writing

PART 1 – PRODUCTS

(NOT USED)

PART 1 – EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01070

ABBREVIATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The following is a partial list of typical abbreviations which may be used in the Specifications, and the organizations to which they refer:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ACIFS	-	American Cast Iron Flange Standards
AFBMA	-	Anti-Friction Bearing Manufacturer's Association
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIA	-	American Institute of Architects
AISC	-	American Institute of Steel Construction
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standard Institute
API	-	American Petroleum Institute
ASCE	-	American Society of Civil Engineers
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CEMA	-	Conveyor Equipment Manufacturer's Association
CRSI	-	Concrete Reinforcing Steel Institute
DIPRA	-	Ductile Iron Pipe Research Association
Fed Spec	-	Federal Specifications
IEEE	-	Institute of Electrical and Electronic Engineers
IPCEA	-	Insulated Power Cable Engineers Association
ISO	-	Insurance Services Offices
NBS	-	National Bureau of Standards
NCDOT	-	North Carolina Department of Transportation
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturers Association
OSHA	-	Occupational Safety and Health Act
PCI	-	Precast Concrete Institute
UL	-	Underwriters Laboratories, Inc.
USGS	-	United States Geological Survey

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01090

REFERENCE STANDARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Wherever reference is made to any published standards, codes, or standard specifications, it shall mean the latest standard code, specification, or tentative specification of the technical society, organization, or body referred to, which is in effect at the date of invitation for Bids.
- B. All materials, products, and procedures used or incorporated in the work shall be in strict conformance with applicable codes, regulations, specifications, and standards.
- C. A partial listing of codes, regulations, specifications, and standards includes the following:

Air Conditioning and Refrigeration Institute (ARI)

Air Diffusion Council (ADC)

Air Moving and Conditioning Association (AMCA)

The Aluminum Association (AA)

American Architectural Manufacturers Association (AAMA)

American Concrete Institute (ACI)

American Gear Manufacturers Association (AGMA)

American Hot Dip Galvanizers Association (AHDGA)

American Institute of Steel Construction, Inc. (AISC)

American Iron and Steel Institute (AISI)

American National Standards Institute (ANSI)

American Society of Civil Engineers (ASCE)

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

American Standards Association (ASA)

American Water Works Association (AWWA)
American Welding Society (AWS)
American Wood-Preserver's Association (AWPA)
Anti-Friction Bearing Manufacturers Association (AFBMA)
Building Officials and Code Administrators (BOCA)
Conveyor Equipment Manufacturers Association (CEMA)
Consumer Product Safety Commission (CPSC)
Factory Mutual (FM)
Federal Specifications
Instrument Society of America (ISA)
Institute of Electrical and Electronics Engineers (IEEE)
National and Local Fire Codes
Lightning Protection Institute (LPI)
National Electrical Code (NEC)
National Electrical Manufacturer's Association (NEMA)
National Electrical Safety Code (NESC)
National Electrical Testing Association (NETA)
National Fire Protection Association (NFPA)
Regulations and Standards of the Occupational Safety and Health Act (OSHA)
Southern Building Code Congress International, Inc. (SBCCI)
Sheet Metal & Air Conditioning Contractors National Association (SMACCNNA)
Standard Building Code
Standard Mechanical Code
Standard Plumbing Code
Uniform Building Code (UBC)
Underwriters Laboratories Inc. (UL)

- D. Contractor shall, when required, furnish evidence satisfactory to the Engineer that materials and methods are in accordance with such standards where so specified.
- E. In the event any questions arise as to the application of these standards or codes, copies shall be supplied on-site by the Contractor.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 01200
PROJECT MEETINGS

PART 1 -- GENERAL

1.01 PRE-BID MEETING

- A. A pre-bid meeting will be held at the time and place to be designated in the Instructions to Bidders.
- B. The Engineer will be available to discuss the project and answer pertinent questions. No oral interpretation will be made as to the meaning of the Documents. Interpretation, if deemed necessary by the Engineer, will be in the form of an Addendum to the Contract Documents.

1.02 PRECONSTRUCTION MEETING

- A. A preconstruction meeting will be held after Award of Contract, but prior to starting work at the site.
- B. Attendance:
 - 1. Owner
 - 2. Engineer
 - 3. Contractor
 - 4. Major subcontractors
 - 5. Safety representative
 - 6. Representatives of governmental or other regulatory agencies.
- C. Minimum Agenda:
 - 1. Tentative construction schedule
 - 2. Critical work sequencing
 - 3. Designation of responsible personnel
 - 4. Processing of Field Decisions and Change Orders
 - 5. Adequacy of distribution of Contract Documents
 - 6. Submittal of Shop Drawings and samples

7. Procedures for maintaining record documents
8. Use of site and Owner's requirements
9. Major equipment deliveries and priorities
10. Safety and first aid procedures
11. Security procedures
12. Housekeeping procedures
13. Processing of Partial Payment Requests
14. General regard for community relations

1.03 PROGRESS MEETING

- A. Progress meetings will be held monthly at the Percy D. Miller Water Treatment Plant Conference room during the performance of the work of this Contract. Additional meetings may be called as progress of work dictates.
- B. Engineer will preside at meetings and record minutes of proceedings and decisions. Engineer will distribute copies of minutes to participants.
- C. Attendance:
 1. Engineer
 2. Contractor
 3. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda
- D. Minimum Agenda:
 1. Review and approve minutes of previous meetings.
 2. Review progress of Work since last meeting.
 3. Review proposed 30-60 day construction schedule.
 4. Note and identify problems which impede planned progress.
 5. Develop corrective measures and procedures to regain planned schedule.
 6. Revise construction schedule as indicated and plan progress during next work period.
 7. Maintaining of quality and work standards.
 8. Complete other current business.

9. Schedule next progress meeting.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 01300

SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Progress Schedule

1. Within thirty (30) days after issuance of the Notice to Proceed, the Contractor shall prepare and submit three (3) copies of his proposed progress schedule to the Engineer for review and approval.
2. If so required, the schedule shall be revised until it is approved by the Engineer.
3. Schedule shall be updated monthly, depicting progress to the last day of the month and three (3) copies submitted to the Engineer not later than the fifth day of the month, and prior to the application for progress payment. Failure to provide monthly schedule updates will be grounds for the Engineer or Owner to withhold progress payment approval.
4. Schedule shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the work and identifying construction activities for each structure and for each portion of work.
5. Schedule shall be time scaled, identifying the first day of each week. The Schedule shall be provided with estimated dates for Early Start, Early Finish, Late Start and Late Finish. The work shall be scheduled to complete the Project within the Contract time. The Late Finish date shall equal the Contract Completion Date.
6. Schedule shall show duration (number of days) and float for each activity. Float shall be defined as the measure of leeway in starting or completing a scheduled activity without adversely affecting the project completion date established by the Contract Documents.
7. Updated schedule shall show all changes since the previous submittal.
8. All revisions to the schedule must have the prior approval of the Engineer.

B. Equipment and Material Orders Schedule

1. Contractor shall prepare and submit three (3) copies of his schedule of principal items of equipment and materials to be purchased to the Engineer for review and approval.
2. If so required, the schedule shall be revised until it is approved by the Engineer.

3. Schedule shall be updated monthly and three (3) copies submitted to the Engineer not later than the fifth day of every month with the application for progress payment.
4. The updated schedule shall be based on the Progress Schedule developed under the requirements of Paragraph 1.01(A) of this Section.
5. Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:
 - a. Dates on which Shop Drawings are requested and received from the manufacturer.
 - b. Dates on which certification is received from the manufacturer and transmitted to the Engineer.
 - c. Dates on which Shop Drawings are submitted to the Engineer and returned by the Engineer for revision.
 - d. Dates on which Shop Drawings are revised by manufacturer and resubmitted to the Engineer.
 - e. Date on which Shop Drawings are returned by Engineer annotated either "Furnish as Submitted" or "Furnish as Corrected".
 - f. Date on which accepted Shop Drawings are transmitted to manufacturer.
 - g. Date of manufacturer's scheduled delivery.
 - h. Date on which delivery is actually made.

C. Working Drawings

1. Within thirty (30) days after the Notice to Proceed, each prime Contractor shall prepare and submit three (3) copies of his preliminary schedule of Working Drawing submittals to the Engineer for review and approval. If so required, the schedule shall be revised until it is approved by the Engineer.
2. Working Drawings include, but are not limited to, Shop Drawings, layout drawings in plan and elevation, installation drawings, elementary wiring diagrams, interconnecting wiring diagrams, manufacturer's data, etc. Contractor shall be responsible for securing all of the information, details, dimensions, Drawings, etc., necessary to prepare the Working Drawings required and necessary under this Contract and to fulfill all other requirements of his Contract. Contractor shall secure such information, details, Drawings, etc., from all possible sources including the Drawings, Working Drawings prepared by subcontractors, Engineers, suppliers, etc.
3. Working Drawings shall accurately and clearly present the following:
 - a. All working and installation dimensions.
 - b. Arrangement and sectional views.

- c. Units of equipment in the proposed positions for installation, details of required attachments and connections, and dimensioned locations between units and in relation to the structures.
 - d. Necessary details and information for making connections between the various trades including, but not limited to, power supplies and interconnecting wiring between units, accessories, appurtenances, etc.
- 4. In the event that the Engineer is required to provide additional engineering services as a result of a substitution of materials or equipment by the Contractor, the additional services will be provided in accordance with Section 01010 - Summary of Work, and will be covered in supplementary or revised Drawings which will be issued to the Contractor. All changes indicated that are necessary to accommodate the equipment and appurtenances shall be incorporated into the Working Drawings submitted to the Engineer.
- 5. Working Drawings specifically prepared for this Project shall be on approved reproducible material sheets of the same size as the Drawings. Working Drawings shall conform to recognized drafting standards and be neat, legible and drawn to a large enough scale to show in detail the required information.
- 6. The Drawings are used for engineering and general arrangement purposes only and are not to be used for Working Drawings.
- 7. Shop Drawings
 - a. Contractor shall submit for review by the Engineer Shop Drawings for all fabricated work and for all manufactured items required to be furnished by the Contract Documents.
 - b. Structural and all other layout Drawings prepared specifically for the Project shall have a plan scale of not less than 1/4-inch = 1 foot.
 - c. Where manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted in lieu of prepared Shop Drawings, such submittals shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submittals showing only general information are not acceptable.
- 8. Layout and Installation Drawings
 - a. Contractor shall prepare and submit for review by the Engineer layout and installation drawings for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc., under this Contract. The final dimensions, elevation, location, etc., of pipe, valves, fittings, sewers, ducts, conduits, electrical cable trays, equipment, etc., may depend upon the dimensions of equipment and valves to be furnished by the Contractor.

- b. Layout and installation drawings are required for both interior and exterior piping, valves, fittings, sewers, drains, heating and ventilation ducts, conduits, plumbing lines, electrical cable trays, etc.
- c. Layout and installation Drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.
- d. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.
- e. The Drawings for pipes, ducts, conduits, etc., shall show all 3-inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.

9. Contractor Responsibilities

- a. All submittals from subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for checking. Contractor shall thoroughly check all Drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors, manufacturers, or suppliers by the Contractor for correction before submitting them to the Engineer.
- b. All submittals shall be bound, dated, properly labeled and consecutively numbered. Information on the label shall indicate Specification Section, Drawing number, subcontractor's, manufacturer's or supplier's name and the name or type of item the submittal covers. Each part of a submittal shall be marked and tabulated.
- c. Working Drawings shall be submitted as a single complete package including all associated drawings relating to a complete assembly of the various parts necessary for a complete unit or system.
- d. Shop Drawings shall be submitted as a single complete package for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnection wiring diagrams for construction.
- e. ALL SUBMITTALS SHALL BE THOROUGHLY CHECKED BY THE CONTRACTOR FOR ACCURACY AND CONFORMANCE TO THE INTENT OF THE CONTRACT DOCUMENTS BEFORE BEING SUBMITTED TO THE ENGINEER AND SHALL BEAR THE CONTRACTOR'S STAMP OF APPROVAL CERTIFYING THAT THEY HAVE BEEN SO CHECKED. SUBMITTALS WITHOUT THE CONTRACTOR'S STAMP OF APPROVAL

WILL NOT BE REVIEWED BY THE ENGINEER AND WILL BE RETURNED TO THE CONTRACTOR.

- f. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor's letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure.
- g. No materials or equipment shall be ordered, fabricated, shipped or any work performed until the Engineer returns to the Contractor the submittals, herein required, annotated "Furnish as Submitted", "Furnish as Corrected", or "Furnish as Corrected – Confirm." If a submittal is returned "Furnish as Corrected – Confirm" the portions of work covered by the submittal that require confirmation by the Engineer shall not be ordered, fabricated, shipped, or any work performed until those portions are approved in a subsequent submittal either "Furnish as Submitted" or "Furnish as Corrected".
- h. Where errors, deviations, and/or omissions are discovered at a later date in any of the submittals, the Engineer's prior review of the submittals does not relieve the Contractor of the responsibility for correcting all errors, deviations, and/or omissions.

10. Procedure for Review

- a. Submittals shall be transmitted in sufficient time to allow the Engineer at least thirty (30) working days for review and processing.
- b. Contractor shall transmit three (3) copies of all technical data or drawing to be reviewed.
- c. Submittal shall be accompanied by a letter of transmittal containing date, project title, Contractor's name, number and titles of submittals, a list of relevant specification sections, notification of departures from any Contract requirement, and any other pertinent data to facilitate review.
- d. Submittals will be annotated by the Engineer in one of the following ways:
 - "Furnish as Submitted" (FAS) - no exceptions are taken
 - "Furnish as Corrected" (FAC) - minor corrections are noted and shall be made.
 - "Furnish as Corrected – Confirm" (FACC) - some corrections are noted and a partial resubmittal or additional information are required as specifically requested.
 - "Revise and Resubmit" (R&R) - major corrections are noted and a full resubmittal is required.
 - "For Information Only – Not Reviewed" (FIO) – submittal was received and was distributed for record purposes without review.

- e. If a submittal is satisfactory to the Engineer in full or in part, the Engineer will annotate the submittal "Furnish as Submitted", "Furnish as Corrected", or "Furnish as Corrected – Confirm", retain four (4) copies and return remaining copies to the Contractor. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor. In the case of "Furnish as Corrected – Confirm" a partial resubmittal or additional information are required as specifically requested.
 - f. If a full resubmittal is required, the Engineer will annotate the submittal "Revise and Resubmit" and transmit three (3) copies to the Contractor for appropriate action. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor.
 - g. Contractor shall continue to resubmit submittals in part if they are returned "Furnish as Corrected – Confirm" or in full if they are returned "Revise and Resubmit" as required by the Engineer until submittals are acceptable to the Engineer. It is understood by the Contractor that Owner may charge the Contractor the Engineer's charges for review in the event a submittal is not approved (either "Furnish as Submitted" or "Furnish as Corrected") by the third submittal for a system or piece of equipment. These charges shall be for all costs associated with engineering review, meetings with the Contractor or manufacturer, etc., commencing with the fourth submittal of a system or type of equipment submitted for a particular Specification Section.
 - h. Acceptance of a Working Drawing by the Engineer will constitute acceptance of the subject matter for which the Drawing was submitted and not for any other structure, material, equipment or appurtenances indicated or shown.
11. Engineer's Review
- a. Engineer's review of the Contractor's submittals shall in no way relieve the Contractor of any of his responsibilities under the Contract. An acceptance of a submittal shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Drawings and Specifications.
 - b. Engineer's review will be confined to general arrangement and compliance with the Contract Drawings and Specifications only, and will not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of trades, etc.
12. Record Working Drawings
- a. Contractor shall maintain current record drawings onsite for the Engineer's review. Record drawings shall be updated monthly at a minimum.
 - b. Prior to final payment, the Contractor shall furnish the Engineer one complete set of all accepted Working Drawings, including Shop Drawings, for equipment, piping, electrical work, heating system, ventilating system, air

conditioning system, instrumentation system, plumbing system, structural, interconnection wiring diagrams, etc.

- c. Working Drawings furnished shall be corrected to include any departures from previously accepted Drawings.

D. Operation and Maintenance Manuals

1. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not less than 60 days prior to the start-up of the respective equipment.
2. The preliminary manuals shall be reviewed by the Engineer prior to the Contractor submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Contractor with required revisions noted, or the acceptance of the Engineer noted.
3. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts.
4. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contact information.
5. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.
6. Following the Engineer's review of the preliminary manuals, the Contractor shall submit three (3) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Engineer. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents. Failure of the final manuals to reflect the required revisions noted by the Engineer during a review of the Preliminary documents will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not less than two week prior to equipment start-up.

E. Certified Shop Test Reports

1. Each piece of equipment for which pressure, head, capacity, rating, efficiency, performance, function or special requirements are specified or implied shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and applicable test codes and standards. Contractor shall keep the Engineer advised of the scheduling of shop tests so that the Engineer may arrange for the witnessing or inspection at the proper time and place.

2. The Contractor shall secure from the manufacturers three (3) copies of the actual test data, the interpreted results and a complete description of the testing facilities and testing setup, all accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company and notarized. These reports shall be forwarded to the Engineer for review.
3. In the event any equipment fails to meet the test requirements, the manufacturer shall make all necessary changes, adjustments or replacements and the tests shall be repeated, at no additional cost to the Owner or Engineer, until the equipment test requirements are acceptable to the Engineer.
4. No equipment shall be shipped to the Project until the Engineer notifies the Contractor, in writing, that the shop test reports are acceptable.

F. Samples

1. Contractor shall furnish for review all samples as required by the Contract Documents or requested by the Engineer.
2. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly labeled to show the nature of the material, trade name of manufacturer and location of the work where the material represented by the sample will be used.
3. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp of approval certifying that they have been so checked. Transportation charges on samples submitted to the Engineer shall be prepaid by the Contractor.
4. Engineer's review will be for compliance with the Contract Documents and his comments will be transmitted to the Contractor with reasonable promptness.
5. Accepted samples will establish the standards by which the completed work will be judged.

G. Construction Photographs

1. The Contractor shall engage a competent individual to take photographs at the locations and at such stages of the construction as directed by the Engineer.

1.05 SUBSTITUTIONS

- A. Requests for substitutions of equipment or materials shall conform to the requirements of the General Conditions, Supplemental Conditions, and as hereinafter specified.
1. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Owner and Engineer to determine if the proposed substitution is equal.

2. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
 3. A list of installations where the proposed substitution is equal.
 4. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the Owner.
- B. Where the approval of a substitution requires revision or redesign of any part of the work, including that of other Contracts, all such revision and redesign, and all new drawings and details therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to the approval of the Owner and Engineer.
- C. In the event that the Engineer is required to provide additional engineering services, then the Engineer's charges for such additional services shall be charged to the Contractor by the Owner in accordance with the requirements of the General Conditions, and the Supplemental Conditions.
- D. In all cases the Owner and Engineer shall be the judge as to whether a proposed substitution is to be approved. The Contractor shall abide by their decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No substitute items shall be used in the work without written approval of the Owner and Engineer.
- E. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Engineer in considering a substitution proposed by the Contractor or by reason of the failure of the Engineer to approve a substitution proposed by the Contractor.
- F. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 01400
QUALITY CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Testing Laboratory Services

1. Laboratory testing and checking required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided and paid for by the Owner unless otherwise indicated in the Specifications.
2. Materials to be tested include, but are not necessarily limited to the following: cement, concrete aggregate, concrete, bituminous paving materials, structural and reinforcing steel, waterproofing, select backfill, crushed stone or gravel and sand.
3. Tests required by the Owner shall not relieve the Contractor from the responsibility of supplying test results and certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.
4. Procedure
 - a. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests.
 - b. The collection, field preparation and storage of field samples and test specimens shall be as directed by the Engineer with the cooperation of the Contractor.
5. Significance of Tests
 - a. Test results shall be binding on both the Contractor and the Owner, and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the Owner, that the initial samples were not representative of actual conditions.
6. Supplementary and Other Testing
 - a. Nothing shall restrict the Contractor from conducting tests he may require. Should the Contractor at any time request the Owner to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the Owner. Testing of this nature shall be conducted at the Contractor's expense.

1.02 FIELD TESTING OF EQUIPMENT

- A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions.
- B. Preliminary Field Tests, Yellow Tag
 1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall check the equipment for alignment, direction of rotation and that it is free from defects.
 2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
 3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.
 4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.
- C. Final Field Tests, Blue Tag
 1. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ducting, electrical controls and mechanical operations.
 2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
 3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Equipment shall be tested for the characteristics as specified for the item.
 4. Each pump shall be tested at maximum rated speed for at least four points on the pump curve for capacity, head and electric power input. The rated motor nameplate current and power shall not be exceeded at any point within the specified range. Vibrometer readings shall be taken when directed by the Engineer and the results recorded. Additional tests shall be performed as prescribed in other sections of the Specifications.
 5. Pumps with drive motors rated at less than five horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.

6. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the Owner.
7. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
8. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
9. All costs in connection with such tests including all materials, equipment, instruments, labor, etc., shall be borne by the Contractor.

1.03 IMPERFECT WORK, EQUIPMENT, OR MATERIALS

- A. Any defective or imperfect work, equipment, or materials furnished by the Contractor which is discovered before the final acceptance of the work, as established by the Certificate of Substantial Completion, or during the subsequent guarantee period, shall be removed immediately even though it may have been overlooked by the Engineer and estimated for payment. Any equipment or materials condemned or rejected by the Engineer shall be tagged as such and shall be immediately removed from the site. Satisfactory work or materials shall be substituted for that rejected.
- B. The Engineer may order tests of imperfect or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor; and the nature, tester, extent and supervision of the tests will be as determined by the Engineer. If the results of the tests indicate that the required functional capability of the work, equipment, or material was not impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work, equipment, or materials has been impaired, then such work, equipment, or materials shall be deemed imperfect and shall be replaced. The Contractor may elect to replace the imperfect work, equipment, or material in lieu of performing the tests.

1.04 INSPECTION AND TESTS

- A. The Contractor shall allow the Engineer ample time and opportunity for testing materials and equipment to be used in the work. He shall advise the Engineer promptly upon placing orders for material and equipment so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture. The Contractor shall at all times furnish the Engineer and his representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and workmanship. The Contractor must anticipate possible delays that may be caused in the execution of his work due to the necessity of materials and equipment being inspected and accepted for use. The Contractor shall furnish, at his own expense, all samples of materials required by the Engineer for testing, and shall make his own arrangements for providing water, electric power, or fuel for the various inspections and tests of structures and equipment.

- B. The Contractor shall furnish the services of representatives of the manufacturers of certain equipment, as prescribed in other Sections of the Specifications. The Contractor shall also place his orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the Owner with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required of equipment shall be paid for by the Contractor, unless specified otherwise in the Section which covers a particular piece of equipment.

- C. Where other tests or analyses are specifically required in other Sections of these Specifications, the cost thereof shall be borne by the party (Owner or Contractor) so designated in such Sections. The Owner will bear the cost of all tests, inspections, or investigations undertaken by the order of the Engineer for the purpose of determining conformance with the Contract Documents if such tests, inspection, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the Engineer as a result of such tests, inspections, or investigations, the Contractor shall bear the full cost thereof or shall reimburse the Owner for said cost. In this connection, the cost of any additional tests and investigations, which are ordered by the Engineer to ascertain subsequent conformance with the Contract Documents, shall be borne by the Contractor.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01510

TEMPORARY UTILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall provide temporary light and power, heating, water service and sanitary facilities for his operations. The temporary services shall be provided for use throughout the construction period.
- B. Contractor shall coordinate and install all temporary services in accordance with the requirements of the utility companies having jurisdiction and as required by applicable codes and regulations.
- C. At the completion of the work, or when the temporary services are no longer required, the facilities shall be restored to their original conditions.
- D. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges, maintenance, relocation and removal shall be borne by the Contractor at no additional cost to the Owner.
- F. Temporary Light and Power
 - 1. Contractor shall provide temporary light and power as required for his activities.
- G. Temporary Heating
 - 1. The General Contractor shall provide temporary heating, ventilation coverings and enclosures necessary to properly protect all work and materials against damage by dampness and cold, to dry out the work and to facilitate work in all structures.
- H. Temporary Sanitary Service
 - 1. Sanitary conveniences, in sufficient numbers, for the use of all persons employed on the work and properly screened from public observation, shall be provided and maintained at suitable locations by the Contractor, all as prescribed by State Labor Regulations and local ordinances. The contents of same shall be removed and disposed of in a manner consistent with local and state regulations, as the occasion requires.
- I. Temporary Water
 - 1. Contractor shall supply potable water for his employees either by portable containers or drinking fountains.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01520

MAINTENANCE OF UTILITY OPERATIONS DURING CONSTRUCTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The existing pump station will be maintained in continuous operation by the Owner during the entire construction period of all Contracts as hereinafter specified. The intent of this section is to outline the minimum requirements necessary to allow the Owner to continuously operate and maintain the water treatment facility in order to remain in compliance with all permit requirements.
- B. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the Owner and provided that all requirements of these Specifications are fulfilled. The Contractor shall submit any such plan for providing additional temporary facilities to eliminate a constraint to the Engineer for review. Such plans must be approved by the Engineer and Owner prior to the Contractor proceeding.

1.02 GENERAL CONSTRAINTS

- A. The Contractor shall schedule the Work so that the Pump Station is maintained in continuous operation. All short-term system or partial systems shutdowns and diversions shall be approved by the Engineer. Long-term process shutdowns and diversions shall conform to the requirements hereinafter specified and shall be minimized by the Contractor as much as possible. If in the judgement of the Engineer a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period shall commence at a time approved by the Owner, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed and normal operation is restored. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back into service.
- B. The Contractor shall schedule short-term and long-term shutdowns in advance and shall present all desired shutdowns in the 30 and 60-day schedules at the progress meetings (see Section 01200). Shutdowns shall be fully coordinated with the Plant Superintendent at least 48 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the short-term and long-term shutdowns and diversions.
- C. The Owner shall have the authority to order Work stopped or prohibited that would, in his opinion, unreasonably result in interrupting the necessary functions of the plant operations.
- D. If the contractor impairs performance or operation as a result of not complying with specified provisions for maintaining plant operations, then the contractor shall immediately make all repairs or replacements and do all work necessary to restore operation to the satisfaction of

the Engineer. Such work shall progress continuously to completion on a 24-hours per day, seven work days per week basis.

- E. The Contractor shall provide the services of emergency repair crews on call 24-hours per day to affect repairs to portions of the plant affected by the Contractor's operations.

1.03 SPECIFIC OPERATIONAL CONSTRAINTS

- A. Contractor Shall Maintain Standby power with a minimum of 2,000 gallon fuel supply at all times. Pump Station Shutdowns are limited to a 4 hour duration

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01530

PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of his operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.
- B. Contractor shall comply promptly with such safety regulations as may be prescribed by the Owner or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, his employees. In the event of the Contractor's failure to comply, the Owner may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the Engineer to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.
- C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at his own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

1.02 PROTECTION OF WORK AND MATERIAL

- A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract.
- B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at his own expense. Protection measures shall be subject to the approval of the Engineer.

1.03 BARRICADES, WARNING SIGNS AND LIGHTS

- A. The General Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

- B. Each Contractor shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, the Owner's operating personnel, or those visiting the site.

1.04 EXISTING UTILITIES AND STRUCTURES

- A. The term existing utilities shall be deemed to refer to both publicly-owned and privately-owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.
- B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.
- C. Prior to beginning any excavation work, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that an interference exists, he shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. In the event the Contractor fails to bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the Owner.
- D. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to insure uninterrupted of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at his own expense in a manner approved by the Engineer and further subject to the requirements of any authority having jurisdiction. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.
- E. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the Engineer and the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the Engineer may, at his discretion, have the respective authority to provide such support or protection as may be necessary to insure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 01540

DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials and equipment to demolish buildings, structures, equipment, tanks, fixtures, anchors, supports, piping and accessories designated to be removed on the Drawings.

1.02 TITLE TO EQUIPMENT AND MATERIALS

- A. Contractor shall have no right or title to any of the equipment, materials or other items to be removed from the existing buildings or structures unless and until said equipment, materials and other items have been removed from the premises. The Contractor shall not sell or assign, or attempt to sell or assign any interest in the said equipment, materials or other items until the said equipment, materials or other items have been removed.
- B. Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

1.03 CONDITION OF STRUCTURES AND EQUIPMENT

- A. The Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practicable.
- C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

3.01 DEMOLITION AND REMOVALS

- A. The removal of all equipment and piping, and all materials from the demolition of buildings and structure shall be done by the Contractor and shall become the Contractor's property, and shall be removed from the site.
- B. Contractor shall de-energize all panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation such as flow, level and/or other meters, wiring, and similar power equipments prior to removal. Any electric panels or equipment which are to be retained shall be relocated or isolated by the Contractor prior to the removal of the equipment specified herein.
- C. The Contractor shall proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the plant in continuous operation as described in Section 01520, Maintenance of Utility Operations During Construction, and shall proceed only after approval of the Engineer.
- D. Any equipment piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing facilities shall be replaced to the satisfaction of the Engineer at no cost to the Owner.
- E. Excavation caused by demolitions shall be backfilled as specified or shown.

3.02 PROTECTION

- A. Demolition and removal work shall be performed by competent experienced workmen for the various type of demolition and removal work and shall be carried out through to completion with due regard to the safety of Owner employees, workmen on-site and the public. The work shall be performed with as little nuisance as possible.
- B. The work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes, and as hereinafter specified.
- C. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring and bracing requirements so as to prevent any damage to new or existing construction.
- D. The Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
- E. The Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

- F. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled or equipment moved.
- G. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations under this Section shall be protected by dust-proof partitions and other adequate means.
- H. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.
- I. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
- J. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.03 WORKMANSHIP

- A. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or items designated for reuse or to remain. The Contractor shall perform patching, restoration and new work in accordance with applicable Technical Sections of the Specifications and in accordance with the details shown on the Drawings. Prior to starting of work, the Contractor shall provide a detailed description of methods and equipment to be used for each operation and the sequence thereof for review by the Engineer.
- B. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately 1-inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable Sections of these Specifications, as shown on the Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate Sections of these Specifications, as shown on the Drawings, and as directed and approved by the Engineer.
- C. The Contractor shall finish adjacent existing surfaces to new work to match the specified finish for new work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.
- D. The Contractor shall cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
- E. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the work.

3.04 MAINTENANCE

- A. The Contractor shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.
- B. The Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.
- C. At reasonable intervals during the progress of the demolition and removal work or as directed by the Engineer, the Contractor shall clean the site and properties, and dispose of waste materials, debris and rubbish.

- END OF SECTION -

SECTION 01550

SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Access Road

1. Site access is restricted by means of a key card controlled gate. Contractor shall coordinate with Owner for access.
2. The existing access road shall be suitably maintained by the Contractor during construction. Contractor shall not be permitted to restrict Owner access to existing facilities

B. Parking Areas

1. Contractor shall maintain suitable parking areas for his construction personnel on the project site where approved by the Engineer and the Owner.

C. Restoration

1. At the completion of the work, the surfaces of land used for parking areas shall be restored by each Contractor to its original condition and to the satisfaction of the Engineer.

D. Storage of Equipment and Materials

1. Contractor shall store his equipment and materials at the job site in accordance with the requirements of the General Conditions, the Supplemental Conditions, and as hereinafter specified. All equipment and materials shall be stored in accordance with manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations and rulings of the public authority having jurisdiction. Where space or strip heaters are provided within the enclosure for motors, valve operators, motor starters, panels, instruments, or other electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and being operated according to its intended use.
2. Contractor shall enforce the instructions of Owner and Engineer regarding the posting of regulatory signs for loadings on structures, fire safety, and smoking areas.
3. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

4. Contractor shall not store unnecessary materials or equipment on the job site, and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
5. Materials shall not be placed within ten (10) feet of fire hydrants. Gutters, drainage channels and inlets shall be kept unobstructed at all times.
6. Contractor shall provide adequate temporary storage buildings/facilities, if required, to protect materials or equipment on the job site.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01700
PROJECT CLOSEOUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Final Cleaning

1. At the completion of the work, the Contractor shall remove all rubbish from and about the site of the work, and all temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the work. Contractor shall broom clean paved surfaces and rake clean other surfaces of grounds.
2. Contractor shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; dirty filters and burned out lights replaced as required; all glass surfaces cleaned and floors cleaned and polished so as to leave work in a clean and new appearing condition.
3. Contractor shall maintain cleaning until project, or portion thereof, is occupied by the Owner.

B. Spare Parts and Special Tools

1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.
2. Contractor shall also furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one-hundred and twenty (120) days for the particular installation.
3. All parts shall be securely boxed and tagged, and clearly marked on the box and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
4. Contractor shall furnish at no additional cost to the Owner with each piece of equipment as a minimum, one (1) complete set, or the number of sets called for in the Technical Specifications, of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
5. Contractor shall submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished

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in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

C. Equipment Start-Up Services

1. Equipment start-up period, for the training of plant personnel, shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for the part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
2. During the equipment start-up period the Contractor shall furnish, at no additional cost to the Owner the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 - a. Assist in the start-up and operations of the equipment.
 - b. Assist in the training of plant personnel, designated by the Owner in the proper operation and maintenance of the equipment.
3. The Owner shall:
 - a. Provide the necessary plant personnel to be instructed in the operation and maintenance of the equipment. The Owner's personnel shall operate all equipment.
 - b. Pay for all fuel, power and chemicals consumed beyond quantities specified in the Contract Documents. The Contractor shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.
4. Contractor shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total plant operation.
5. Upon completion of a minimum of ten (10) consecutive and continuous days of satisfactory operation, or the number of days called for in the Technical Specifications, the Owner will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.
6. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item and the minimum one (1) year guarantee period, or the guarantee period called for in the Technical Specifications for the item shall start after satisfactory replacement and testing of the item.

D. Final Cleanup; Site Rehabilitation

1. Before finally leaving the site, the Contractor shall wash and clean all exposed surfaces which have become soiled or marked, and shall remove from the site of

work all accumulated debris and surplus materials of any kind which result from his operation, including construction equipment, tools, sheds, sanitary enclosures, etc. The Contractor shall leave all equipment, fixtures, and work, which he has installed, in a clean condition. The completed project shall be turned over to the Owner in a neat and orderly condition.

2. The site of the work shall be rehabilitated or developed in accordance with other sections of the Specifications and the Drawings. In the absence of any portion of these requirements, the Contractor shall completely rehabilitate the site to a condition and appearance equal or superior to that which existed just prior to construction, except for those items whose permanent removal or relocation was required in the Contract Documents or ordered by the Owner.

E. Final Inspection

1. Final cleaning and repairing shall be so arranged as to be finished upon completion of the construction work. The Contractor will make his final cleaning and repairing, and any portion of the work finally inspected and accepted by the Engineer shall be kept clean by the Contractor, until the final acceptance of the entire work.
2. When the Contractor has finally cleaned and repaired the whole or any portion of the work, he shall notify the Engineer that he is ready for final inspection of the whole or a portion of the work, and the Engineer will thereupon inspect the work. If the work is not found satisfactory, the Engineer will order further cleaning, repairs, or replacement.
3. When such further cleaning or repairing is completed, the Engineer, upon further notice, will again inspect the work. The "Final Payment" will not be processed until the Contractor has complied with the requirements set forth, and the Engineer has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

F. Project Close Out

1. As construction of the project enters the final stages of completion, the Contractor shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:
 - a. Scheduling equipment manufacturers' visits to site.
 - b. Required testing of project components.
 - c. Scheduling start-up and initial operation.
 - d. Scheduling and furnishing skilled personnel during initial operation.
 - e. Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the Engineer's "Punch" Lists.

- f. Attend to any other items listed herein or brought to the Contractor's attention by the Engineer.
2. Just before the Engineer's Certificate of Substantial Completion is issued, the Contractor shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:
 - a. Clean all glass and adjust all windows and doors for proper operation.
 - b. Clean all finish hardware after adjustment for proper operation.
 - c. Touch up marks or defects in painted surfaces and touch up any similar defects in factory finished surfaces.
 - d. Wax all resilient flooring materials.
 - e. Remove bitumen from gravel stops, fascias, and other exposed surfaces.
 - f. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.
3. In addition, and before the Certificate of Substantial Completion is issued, the Contractor shall submit to the Engineer (or to the Owner if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:
 - a. Test results of project components.
 - b. Performance Affidavits for equipment.
 - c. Certification of equipment or materials in compliance with Contract Documents.
 - d. Operation and maintenance instructions or manuals for equipment.
 - e. One set of neatly marked-up record drawings showing as-built changes and additions to the work under his Contract.
 - f. Any special guarantees or bonds (Submit to Owner).
 - g. Licensed surveyor's report showing elevations of weirs specified in the Contract Drawings and the final surveyed elevation.
4. The Contractor's attention is directed to the fact that required certifications and information under Item 3 above, must actually be submitted earlier in accordance with other Sections of the Specifications.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 02200

EARTHWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, equipment and materials required to complete all work associated with excavation, including but not limited to off-site borrow excavation, dewatering, backfill, foundation and backfill stone, site grading, and other related and incidental work as required to complete the work shown on the Drawings and specified herein.
- B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.
- C. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Virginia Department of Transportation Standard Specifications for Roads and Bridges, latest edition.

2. American Society for Testing and Materials (ASTM):

ASTM C 127 Test for Specific Gravity and Absorption of Coarse Aggregate.

ASTM C 136 Test for Sieve Analysis of Fine and Coarse Aggregates.

ASTM D 422 Particle Size Analysis of Soils.

ASTM D 423 Test for Liquid Limit of Soils.

ASTM D 424 Test for Plastic Limit and Plasticity Index of Soils.

ASTM C 535 Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM D 698	Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop.
ASTM D1556	Test for Density of Soil in Place by the Sand-Cone Method.
ASTM D1557	Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop.
ASTM D2049	Test Method for Relative Density of Cohesionless Soils.
ASTM D2167	Test for Density of Soil in Place by the Rubber-Balloon Method.
ASTM D2216	Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
ASTM D2487	Test for Classification of Soils for Engineering Purposes.
ASTM D2922	Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.04 SUBSURFACE CONDITIONS

- A. Information on subsurface conditions is referenced under Division 1, General Requirements.
- B. Attention is directed to the fact that there may be water pipes, storm drains and other utilities located in the area of proposed excavation. Perform all repairs to same in the event that excavation activities disrupt service.

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall submit the following:
 1. Name and location of all material suppliers.
 2. Certificate of compliance with the standards specified above for each source of each material.
 3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

1.06 PRODUCT HANDLING

- A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

PART 2 – PRODUCTS – NOT USED

PART 3 -- EXECUTION

3.01 EXCAVATION

- A. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED EXCAVATION. Excavation shall include the removal of all soil, rock, weathered rock, rocks of all types, boulders, conduits, pipe, and all other obstacles encountered and shown to be removed within the limits of excavation shown on the Drawings or specified herein. The cost of excavation shall be included in the Lump Sum Bid Price and no additional payment will be made for the removal of obstacles encountered within the excavation limits shown on the Drawings and specified herein.
- B. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Engineer. No excavation shall be wasted except as may be permitted by the Engineer. Refer to the drawings for specific location and placement of suitable excavated materials in the formation of embankments, backfill, and structural and roadway foundations. THE ENGINEER AND/OR MATERIALS TESTING CONSULTANT WILL DESIGNATE MATERIALS THAT ARE UNSUITABLE. The Contractor shall furnish off site disposal areas for the unsuitable material. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Contractor shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer and/or materials testing consultant such measures are necessary to provide proper construction.
- C. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.
- D. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas. Excavation requirements and slopes shall be as indicated in the Drawings. The Contractor shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from

slopes. The Contractor shall be required to submit plans of open-cut excavation for review by the Engineer before approval is given to proceed.

- E. The bottom of all excavations for structures and pipes shall be examined by the Engineer and/or materials testing consultant for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer and/or materials testing consultant, additional excavation is required due to the low bearing value of the subgrade material, or if the in-place soils are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, and/or crushed stone or screened gravel as indicated by the Engineer. Payment for such additional work ordered by the Engineer shall be made as an extra by a Change Order in accordance with the General Conditions and Division 1. No payment will be made for subgrade disturbance caused by inadequate dewatering or improper construction methods.
- F. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.
- G. Slides and overbreaks which occur due to negligence, carelessness or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as indicated by the Engineer at no additional cost to the Owner. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.

3.02 EXCAVATION SUPPORT

- A. The Contractor shall furnish, place, and maintain such excavation support which may be required to support sides of excavation or to protect pipes and structures from possible damage and to provide safe working conditions. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing it.
- B. Selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor.
- C. The Contractor shall exercise caution in the installation and removal of supports to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.
- D. Contractor shall monitor movement in the excavation support systems as well as movement at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. Contractor shall be exclusively

responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of his operations.

E. All excavation supports shall be removed upon completion of the work

3.03 PROTECTION OF SUBGRADE

A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:

1. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.
3. The Contractor shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

3.04 BACKFILLING

- A. All excavations shall be backfilled with the type of materials shown on the Drawings
- B. Where excavation support is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that supports will be installed in similar soil conditions or employ other appropriate means to prevent loss of support.

3.05 COMPACTION

A. . Compaction of materials on the project shall be in accordance with the following schedule:

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Crushed Stone Beneath Structures	--	98	12
Select Sand	--	98	8

B. Field density tests will be made by the materials testing consultant to determine if the specified densities have been achieved, and these tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. The Engineer in conjunction with the materials testing consultant will be the judge as to which test method will be the most appropriate. Failure to achieve the specified densities shall require the Contractor to re-compact the material or remove it as required. The Contractor shall, if necessary, increase his compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or

by reducing the thickness of the layers. The Contractor shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.

- C. Testing will be performed as frequently as deemed necessary by the Engineer and/or materials testing consultant. As a minimum, one in-place density test shall be performed for each 1000 cubic yards of embankment placed and 500 cubic yards of backfill placed or one test performed each day for either.

3.6 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS

- A. The Contractor shall remove and dispose of off-site all unsuitable materials. Within thirty (30) consecutive days after Notice to Proceed, the Contractor shall submit to the Engineer for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.
- B. All unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state and local laws and regulations.
- C. The Contractor shall obtain an off-site disposal area prior to beginning demolition or excavation operations.
- D. All excess and unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the propagation of dust.
- E. When all excess and unsuitable material disposal operations are completed, the Contractor shall leave the disposal sites in a condition acceptable to the Owner and Owner(s) of the disposal site(s).

- END OF SECTION -

SECTION 02276

EROSION AND SEDIMENTATION CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off site sedimentation be absolutely minimized.
- B. All Work under this Contract shall be done in conformance with and subject to the limitations of the Virginia Erosion and Sediment Control Handbook (VESCH) and the Virginia Erosion and Sediment Control Law, Regulations and Certification Regulations, as adopted in the Code of Virginia Title 10-1, Chapter 5, Article 4 and Sections 4VAC30-50 and 4VAC50-50 of the Virginia Administration Code.
- C. The Contractor shall comply with all applicable minimum standards set in the Virginia Erosion and Sediment Control Handbook
- D. Due to the nature of the Work required by this Contract, it is anticipated that the location and nature of the erosion and sedimentation control devices will be adjusted on several occasions to reflect the current phase of construction. The construction schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation control provisions shown on the Drawings shall have the prior acceptance of the Engineer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 – Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications, all Work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
 - 1. Code of Virginia, Title 10.1, Chapter 5, Article 4
 - 2. Virginia Erosion and Sediment Control Handbook (VESCH), latest edition.

- B. See Specification Section 01090 - Reference Standards.

1.04 REGULATORY COMPLIANCE

- A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from Warren County. The following document defines the regulatory requirements for this Section 02276.
 - 1. Manual for Erosion and Sediment Control: Contractor shall follow Practices and Standards of the Virginia Erosion and Sediment Control Handbook (VESCH), Third Edition, or latest.

1.05 SUBMITTALS

- A. Prior to the start of the Work, the Contractor shall prepare and submit a plan for applying the temporary and permanent erosion and siltation control measures as shown on the Owner's approved Erosion and Sediment Control Plan. Construction Work shall not commence until the schedule of Work and the methods of operations have been reviewed and approved.
- B. In accordance with the procedures and requirements set forth in the General Conditions Division 1 and Section 01300, the Contractor shall submit the following:
 - 1. Name and location of all material suppliers.
 - 2. Certificate of compliance with the standards specified above
 - 3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

1.06 EROSION AND SEDIMENTATION CONTROL DEVICES

- A. The following erosion and sedimentation control devices shall be incorporated into the Work. Other devices, as necessary and acceptable to the Engineer shall be installed as required.
 - 1. Silt Fence shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Silt fence shall not be installed across streams, ditches or waterways. Silt Fence shall be designed, installed and maintained in accordance with requirements of Section 3.05 of the VESCH.

PART 2 -- MATERIALS

2.01 MATERIALS

- A. Materials for use in erosion and sedimentation control devices shall be in accordance with the Virginia Erosion and Sediment Control Handbook.

2.02 SILT FENCE

- A. Silt Fence shall be installed and maintained in accordance with the Maintenance paragraph, and Section 3.05 of the VESCH, to the satisfaction of the Engineer until the site has been stabilized. The cost of Silt Fence shall include the fabric, posts, wire fabric, excavation and all maintenance and restoration activities required.
- B. Silt Fence shall be a woven geotextile filter fabric made specifically for sediment control. Filter fabric shall not rot when buried and shall resist attack from soil chemicals, alkalies and acids in the pH range from 2 to 13, and shall resist damage due to prolonged ultraviolet exposure. Filter fabric shall be Type FX-11, as manufactured by Carthage Mills, Type 910SC, as manufactured by Synthetic Industries, Inc., Amoco 2130 as manufactured by Amoco Fabrics & Fibers Co.

PART 3 -- EXECUTION

3.01 INSTALLATION AND MAINTENANCE

- A. Silt fence shall be erected as shown on the Drawings and specified herein. Silt fence shall be erected and maintained to the satisfaction of the Engineer until a vegetative ground cover has been established. Replacement of the filter fabric, if required by the Engineer, will be at the Contractor's expense.
 - 1. Inspect silt fence at least once every 14 days and within 48 hours after each runoff producing rainfall event. Make required repairs immediately.
 - 2. Should the fabric of a silt fence collapse, tear, decompose or become in-effective, replace it promptly.
 - 3. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.
 - 4. Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized. Removal of silt fence shall be permitted only with the prior approval of the Engineer, or the local governing agency.
- B. Additional Requirements
 - 1. All storm sewer piping shall be blocked at the end of every Working day until the inlet is constructed above grade.
 - 2. All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.
 - 3. The Contractor shall provide adequate means to prevent sediment from entering storm drains, curb inlets (curb inlet filter box), ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be

placed upstream of trench or other excavation to prevent sedimentation of offsite areas. In areas where a natural buffer area exists between the Work area and the closest stream or water course, this area shall not be disturbed.

4. The Engineer may direct the Contractor to place additional sediment and erosion control devices at other locations not shown on the Drawings.
5. The Contractor agrees to hold the Owner or any of its agents harmless from any and all liability, loss or damage that may arise out of a violation to the Erosion and Sediment Control Ordinance.
6. The Contractor shall monitor and take precautions to control dust, including, but not limited to, use of water or chemical dust palliative, limiting the number of vehicles allowed on site, minimizing the operating speed of all vehicles.

3.02 INSPECTIONS AND MAINTENANCE

- A. The Contractor shall be responsible for the implementation of the Maintenance and Inspection Procedures.
- B. During inspections the following will be observed and appropriate maintenance procedures taken:
 1. The conformance to specifications and current condition of all erosion and sediment control structures.
 2. The effectiveness and operational success of all erosion and sediment control measures.
 3. The presence of sediments or other pollutants in storm water runoff at all runoff discharge points.
 4. If reasonably accessible, the presence of sediments or other pollutants in receiving Waters.
 5. Evidence of off-site tracking at all locations where vehicles enter or exit the site.

3.03 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

- A. At such time that temporary erosion and control structures are no longer required under this item, the Contractor shall notify the Engineer and Warren County of its intent and schedule for the removal of the temporary structures, and obtain the Engineer's approval in writing prior to removal. Once the Contractor has received such written approval from the Engineer, the Contractor shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage.

- END OF SECTION -

SECTION 03200

REINFORCING STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Virginia Uniform Statewide Building Code
2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice
3. ACI SP66 - ACI Detailing Manual
4. ACI 315 - Details and Detailing of Concrete Reinforcing
5. ACI 318 - Building Code Requirements for Structural Concrete
6. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.
 2. Mill test certificates - 3 copies of each.
 3. Description of the reinforcing steel manufacturer's marking pattern.
 4. Requests to relocate any bars that cause interferences or that result in placing tolerances to be violated.
 5. Proposed supports for each type of reinforcing.
 6. Request to use splices not shown on the Drawings.

1.05 QUALITY ASSURANCE

- A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.

PART 2 -- PRODUCTS

2.01 REINFORCING STEEL

- A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.
- B. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.
- C. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

- A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Slab bolsters shall have gray plastic-coated legs.
- B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris and drill dust with compressed air followed by a wire brush prior to installation of adhesive and reinforcing bar. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Where depth of hole exceeds the length of the static mixing nozzle, a plastic extension hose shall be used to ensure proper adhesive injection from the back of the hole. Injection of adhesive into the hole shall utilize a piston plug to minimize the formation of air pockets. The embedment depth of the bar shall be per manufacturer's recommendations, so as to provide a minimum allowable bond strength that is equal to 125

percent of the yield strength of the bar, unless noted otherwise on the Drawings. The adhesive system shall be "Epcon System G5" as manufactured by ITW Redhead, " HIT-HY 200 Injection Adhesive Anchor System" as manufactured by Hilti, Inc. "SET-XP" as manufactured by Simpson Strong-Tie Co. or "PE-1000+" by Powers Fasteners. Engineer's approval is required for use of this system in locations other than those shown on the Drawings. **Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved by Engineer and Owner.**

PART 3 -- EXECUTION

3.01 FABRICATION

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
- B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.
- C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved by the Engineer to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.

3.03 DELIVERY, STORAGE AND HANDLING

- A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
- B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.04 PLACING

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

- B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.
- E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.
- F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings or authorized in writing by the Engineer. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

3.05 SPLICING

- A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.
- B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.

3.06 INSPECTION

- A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.
- B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

- END OF SECTION -

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.
- B. The requirements in this section shall apply to the following types of concrete:
 - 1. Class A1 Concrete: Normal weight structural concrete to be used in all structures, sidewalks and pavements, except where noted otherwise in the Contract Documents. All concrete shall be Class A1 concrete unless another class is specifically called for on Contract Documents or specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 - Reinforcing Steel

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Virginia Uniform Statewide Building Code
 - 2. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete
 - 3. ACI 301 Specifications for Structural Concrete for Buildings
 - 4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 5. ACI 305 Hot Weather Concreting
 - 6. ACI 306 Cold Weather Concreting
 - 7. ACI 309 Recommended Practice for Consolidation of Concrete
 - 8. ACI 318 Building Code Requirements for Structural Concrete
 - 9. ACI 350 Code Requirements for Environmental Engineering Concrete Structures
 - 10. ASTM C 31 Standard Methods of Making and Curing Concrete Test Specimens in the Field
 - 11. ASTM C 33 Standard Specification for Concrete Aggregates
 - 12. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

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| 13. | ASTM C42 | Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| 14. | ASTM C 88 | Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate |
| 15. | ASTM C 94 | Standard Specification for Ready-Mixed Concrete |
| 16. | ASTM C 114 | Standard Test Method for Chemical Analysis of Hydraulic Cement |
| 17. | ASTM C 136 | Standard Method for Sieve Analysis of Fine and Coarse Aggregate |
| 18. | ASTM C 138 | Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete |
| 19. | ASTM C 143 | Standard Test Method for Slump of Portland Cement Concrete |
| 20. | ASTM C 150 | Standard Specification for Portland Cement |
| 21. | ASTM C 172 | Standard Method of Sampling Fresh Concrete |
| 22. | ASTM C 192 | Standard Method of Making and Curing Concrete Test Specimens in the Laboratory |
| 23. | ASTM C 231 | Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| 24. | ASTM C 260 | Standard Specification for Air-Entraining Admixtures for Concrete |
| 25. | ASTM C 295 | Standard Guide for Petrographic Examination of Aggregates for Concrete |
| 26. | ASTM C 457 | Standard Recommended Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete |
| 27. | ASTM C 494 | Standard Specification for Chemical Admixtures For Concrete |
| 28. | ASTM C 595 | Standard Specification for Blended Hydraulic Cements |
| 29. | ASTM C 618 | Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete |
| 30. | ASTM C 989 | Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars |
| 31. | ASTM C1077 | Recommended Practice for Labs Testing Concrete |
| 32. | ASTM C 1567 | Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method) |

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.
3. Certified current (less than 1 year old) chemical analysis of fly ash or ground granulated blast furnace slag to be used.
4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, aggregate soundness tests, etc.
5. Manufacturer's data on all admixtures stating compliance with required standards.
6. Concrete mix design for each class of concrete specified herein.
7. Field experience records (less than 1 year old) and/or trial mix data (less than 1 year old) for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

- A. Tests on materials used in the production of concrete shall be required as specified in PART 2 -- PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.
- B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.
- C. Field quality control tests, unless otherwise stated, will be performed by a testing laboratory employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

PART 2 -- PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or ground granulated blast furnace slag is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.
2. For concrete mixed with only Portland Cement, the total alkalis in the cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.40% unless aggregates to be used meet the requirements for non-reactivity with alkalis stated in Article 2.05.
3. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or ground granulated blast furnace slag (Article 2.03) the total alkalis in the Portland Cement (calculated as the percentage of NA_2O plus 0.658 times the

percentage of K_2O) shall not exceed 0.85% unless aggregates to be used meet the requirements for non-reactivity with alkalis stated in Article 2.05.

4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Blast Furnace Slag Cement) conforming to ASTM C 595.
2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.
3. Type IS cement shall be an interground blend of Portland Cement and ground granulated blast furnace slag in which the slag constituent is between 35% and 50% of the weight of the total blend.
4. Fly ash and ground granulated blast furnace slag used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.
5. For concrete mixed with Type IP or IS cement, the blended cement combination shall exhibit mean mortar bar expansion of 0.08% or less when tested at 16 days in accordance with ASTM C 1567. The tests shall be made with aggregates proposed for use on the job.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

- A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.
- B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.
- C. Where fly ash is included in the concrete mix to waive the 0.4% alkali requirement of the Portland Cement, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set so that the mean mortar bar expansion of the cement-fly ash mix shall be 0.08% or less when tested at 16 days in accordance with ASTM C 1567. The Portland Cement and aggregates used in

the mix for this test shall be the Portland Cement and aggregates submitted for use on the job.

- D. For concrete to be used in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or ground granulated blast furnace slag in concrete mix, is mandatory.
- E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 GROUND GRANULATED BLAST FURNACE SLAG

- A. Ground granulated blast furnace slag shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.
- B. Where ground granulated blast furnace slag is included in the concrete mix to waive the 0.4% alkali requirement of the Portland Cement, the ground granulated blast furnace slag constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of ground granulated blast furnace slag shall be set so that the mean mortar expansion of the cement-slag mix shall be 0.08% or less when tested at 16 days in accordance with ASTM C 1567. The Portland Cement and aggregates used in the mix for this test shall be the Portland Cement and aggregates submitted for use on the job.
- C. For concrete to be used in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or ground granulated blast furnace slag in concrete mix, is mandatory.
- D. Additional ground granulated blast furnace slag shall not be included in concrete mixed with type IS or IP cement.

2.04 WATER

- A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.
- B. Water shall not contain more than 100 PPM chloride.
- C. Water shall not contain more than 500 PPM dissolved solids.
- D. Water shall have a pH in the range of 4.5 to 8.5.

2.05 AGGREGATES

- A. All aggregates used in normal weight concrete shall conform to ASTM C 33.
- B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

- C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.
- D. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.
- E. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using magnesium sulfate.
- F. When aggregates which are non-reactive with alkalis are desired in order to waive the alkali content requirement of cement as stated in Article 2.01, the following tests shall be performed:
 - 1. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Aggregates containing more than the following quantities of constituents shall be considered potentially reactive:
 - (1) Optically strained, microfractured, or microcrystalline quartz exceeding 5.0%.
 - (2) Chert or chalcedony exceeding 3.0%.
 - (3) Tridymite or cristobalite exceeding 1.0%.
 - (4) Opal exceeding 0.5%.
 - (5) Natural volcanic glass in volcanic rocks exceeding 3.0%.
 - 2. Aggregate shall be evaluated by ASTM C-1567. Aggregate sources which exhibit mean mortar bar expansions at 16 days greater than .08% shall be considered potentially reactive. Tests shall be made with cement proposed for use on the job.
- G. Aggregates which have a lithology which is essentially similar to that of sources in the same region which have been found to be reactive in service shall be considered potentially reactive and the alkali content requirement of cement in Article 2.01 shall apply regardless of the results of the tests above.
- H. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.06 ADMIXTURES

- A. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.
- B. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall conform to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are "Eucon Series" by the Euclid Chemical Company, "Pozzolith Series" by BASF, and "Plastocrete Series" by Sika Corporation.
 2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are "Eucon 37" or Plastol 5000 by the Euclid Chemical Company, "Rheobuild 1000 or Glenium Series" by BASF, and "Daracem 100 or Advaflo Series" by W.R. Grace.
 3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.
 4. A water reducing retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzolith Retarder" by BASF, and "Plastiment" by Sika Corporation.
- C. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.
- D. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review by the Engineer.

2.07 CONCRETE MIX DESIGN

- A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

- B. Structural concrete shall conform to the following requirements. Cementitious materials refers to the total combined weight of all cement, fly ash, and ground granulated blast furnace slag contained in the mix.
1. Compressive Strength (28-Day)
 - a. Concrete Class A1

4,500 psi (minimum)
6,500 psi (maximum)
 2. Maximum water/cementitious materials ratio, by weight
 - a. Concrete Class A1

0.42

 3. Slump range

4" nominal unless high range water reducing admixture is used. 3" max. before addition of high range water reducing admixture.

 4. Air Content
 - a. Class A1

6% ±1.5%

PART 3 -- EXECUTION

3.01 PRODUCTION OF CONCRETE

- A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.
- B. Ready-Mixed Concrete
1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
 2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
 3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.
6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:
 - a. Date and truck number
 - b. Ticket number
 - c. Mix designation of concrete
 - d. Cubic yards of concrete
 - e. Cement brand, type and weight in pounds
 - f. Weight in pounds of fine aggregate (sand)
 - g. Weight in pounds of coarse aggregate (stone)
 - h. Air entraining agent, brand, and weight in pounds and ounces
 - i. Other admixtures, brand, and weight in pounds and ounces
 - j. Water, in gallons, stored in attached tank
 - k. Water, in gallons, maximum that can be added without exceeding design water/cement ratio
 - l. Water, in gallons, actually used (by truck driver)
 - m. Time of loading
 - n. Time of delivery to job (by truck driver)
7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.
8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

3.02 CONCRETE PLACEMENT

- A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.
- B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be

retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.

- C. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.
- D. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cement ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.
- E. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.08 of this Section.
- F. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.
- G. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.
- H. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.
- I. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.
- J. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.
- K. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of

freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

- L. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.
- M. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.
- N. To prevent feathered edges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.
- O. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.03 PLACING FLOOR SLABS ON GRADE

- A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the Engineer.
- B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.
- C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.
- D. Thirty-pound felt paper shall be provided between edges of slab-on-grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.
- E. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03350 - Concrete Finishes.

3.04 CONCRETE WORK IN COLD WEATHER

- A. Cold weather concreting procedures shall conform to the requirements of ACI 306.
- B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.
- C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.05 CONCRETE WORK IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirements of ACI 305.
- B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand in position prior to each placing operation.
- C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.
- D. The temperature of the concrete mix when placed shall not exceed 90°F.
- E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.
- F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.
- G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.06 QUALITY CONTROL

A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the testing firm's personnel as required for concrete testing.
2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall provide assistance to the testing laboratory in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the Engineer by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material or labor costs due to such eventualities.
2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.
3. Concrete with a specified nominal slump shall be placed having a slump within 1" (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the Engineer in accordance with ASTM C 138.
2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the Engineer in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.
3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the Engineer and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.
2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.
3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The Engineer will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.
4. The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimen are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.
5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the work day and one recording at the end of the work day.
6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.
7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.

2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.
 - a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix.
 - b. No individual compressive strength test results falls below the minimum specified strength by more than 500 psi.
 - c. No more than 10% of the compressive tests have strengths greater than the maximum strength specified.
 3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.
 4. In the event that condition 2B is not met, additional tests in accordance with Article 3.08, paragraph H shall be performed.
 5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:
 - a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.
 - b. Maintain or add temporary structural support as required.
 - c. Correct the mix for the next concrete placement operation, if required to remedy the situation.
 6. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the Owner.
- G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.
- H. Additional Tests
1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.
 2. In the event the 28-day test cylinders fail to meet the minimum strength requirements, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.
 - a. Three cores shall be taken for each sample in which the strength requirements were not met.

- b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by an independent testing laboratory to be selected by the Engineer.
 - c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.
 - d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.
 - e. The diameter of core specimens should be at least 3 times the maximum nominal size of the coarse aggregate used in the concrete, but must be at least 2-inches in diameter.
 - f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.
 - g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.
 - h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.
- 3. In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage an independent test laboratory to be selected by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.
 - 4. Concrete placed with compressive strengths greater than the maximum strength specified shall be removed and replaced or repaired as deemed necessary by the Engineer.

3.07 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.
- B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed by the Engineer.

- C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed by the Engineer. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed by the Engineer.
- D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced, or repaired as directed by the Engineer. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an epoxy injection system approved by the Engineer. Non-structural cracks shall be repaired using a hydrophilic resin pressure injected grout system approved by the Engineer, unless other means of repair are deemed necessary and approved by the Engineer. Extensive repair or replacement will be considered for concrete placed having compressive strengths greater than maximum strength specified. All repair work shall be performed at no additional cost to the Owner.
- E. Concrete which fails to meet the strength requirements as outlined in Article 3.08, paragraph F, will be analyzed by the Engineer as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be directed by the Engineer.

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| 10. | AWS D1.2 | Structural Welding Code - Aluminum |
| 11. | AWS D1.6 | Structural Welding Code – Stainless Steel |
| 12. | Aluminum Association | Specifications for Aluminum Structures |
| 13. | ASTM A572/A572M-94C | Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50 |
| 14. | ASTM A36 | Standard Specification for Carbon Structural Steel |
| 15. | ASTM A325 | Standard Specification for High-Strength Bolts for Structural Steel Joints |
| 16. | ASTM A489 | Standard Specification for Eyebolts |
| 17. | ASTM A490 | Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints |
| 18. | ASTM A563 | Standard Specifications for Carbon and Alloy Steel Nuts |
| 19. | ASTM D1785 | Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe |
| 20. | ASTM E488 | Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements |
| 21. | ASTM F436 | Standard Specification for Hardened Steel Washers |
| 22. | ASTM F467 | Standard Specification for Nonferrous Nuts for General Use |
| 23. | ASTM F593 | Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs |
| 24. | ASTM F594 | Standard Specification for Stainless Steel Nuts |
| 25. | ASTM F1554 | Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 Submittals
1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 2. Anchor design calculations

3. Manufacturer's installation instructions.
4. Copy of valid certification for each person who is to perform field welding.
5. Certified weld inspection reports, when required.
6. Welding procedures.
7. Installer qualifications.
8. Certification of Installer Training.
9. Inspection Reports.
10. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- C. Installer Training: For concrete adhesive anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Concrete adhesive anchor preparation and installation.
 5. Proof loading/torquing.
- D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

- F. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.
- G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

PART 2 -- PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. Anchor rods shall conform to ASTM F1554 Grade 36 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.
- B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.
- C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.03 CONCRETE ANCHORS

A. General

- 1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data

performed by an approved independent testing laboratory. There are two types used:

- a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.
 - b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.
2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
 3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
 4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.
 5. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consisting of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads is required for all installed equipment. Anchor bolt design shall be provided by the equipment manufacturer.

D. Non-Structural Anchors:

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt 3" by Hilti, Inc., "Wedge-All" by Simpson Strong-Tie Co. or "TruBolt" by ITW Redhead.
- b. Screw Anchors: Screw anchors shall be "Kwik HUS" by Hilti, Inc., "Wedge-Bolt" by Powers Fasteners "Large Diameter Tapcon (LDT) Anchor" by ITW Redhead, or "Titen HD" by Simpson Strong-Tie Co. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
- c. Sleeve Anchors: Sleeve anchors shall be "HSL Heavy Duty Sleeve Anchors" by Hilti, Inc. "Power-Bolt" by Powers Fasteners "Dynabolt Sleeve Anchor" by ITW Redhead, or "Sleeve-All" by Simpson Strong-Tie Co.

- d. Drop-In Anchors: Drop-in anchors shall be “Drop-In” by Simpson Strong-Tie Co., “HDI Drop-In Anchor” by Hilti, Inc. or “Multi-Set II Drop-In Anchor” by ITW Redhead.
 - e. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., or “Torq-Cut” by Simpson Strong-Tie Co.
2. Adhesive Anchors:
- a. Adhesive anchors shall be “Epcon A7” or “Epcon C6+ Adhesive Anchoring System” by ITW Redhead, “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET Epoxy Tie High Strength Anchoring Adhesive” or “AT High Strength Anchoring Adhesive” by Simpson Strong-Tie Co., or “Powers AC 100+ Gold Vinylester Injection Adhesive Anchoring System” or “T308+ Epoxy Adhesive Injection System” by Powers Fasteners.
 - b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete.
 - c. Non-structural adhesive anchor embedment depth of the rod shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod unless noted otherwise on the Drawings.

E. Concrete Anchor Rod Materials:

- 1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
- 2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
- 3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

- A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.
- B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of

adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "HIT HY-70 System" as manufactured by Hilti, Inc., or "SET-XP Epoxy-Tie or "AT-XP Acrylic-Tie" as manufactured by Simpson Strong-Tie Co.

- C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.
- D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 ANCHOR INSTALLATION

- A. Anchor Rods, Concrete Anchors, and Masonry Anchors
 - 1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or

elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.
4. All stainless steel threads shall be coated with antiseize lubricant.

B. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.
2. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.
3. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.
2. All stainless steel bolts shall be coated with antiseize lubricant.

3.02 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.03 INSPECTION

A. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

B. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.04 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

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SECTION 15480

GENERATOR FUEL SYSTEM

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Provide a fully integrated complete and operable generator fuel system including but not limited to duplex fuel oil pump set, control systems, main fuel storage tank and accessories (including access ladder and platform), tank monitoring, fuel oil piping, valves, appurtenances and support systems. The detailed system design, installation, startup, and training shall be the responsibility of a single fuel oil system supplier.
- B. The generator day tank shall be provided by the generator supplier as specified in Specification Section 16620 Packaged Engine Generator System. The fuel oil system supplier shall coordinate with the supplier of the generator base mounted day tank to ensure that sufficient sleeves and openings are available for installing the required piping, controls and devices.
- C. Fuel Oil System Supplier shall be Preferred Utilities Mfg. Corp. Danbury, CT, or Equal Contractor shall provide coordination and oversight to ensure a fully operable fuel oil system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 16620 Packaged Engine Generator System

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All Work specified herein shall conform to the applicable requirements of the following:
 - 1. UL- Underwriters Laboratory
 - 2. API – American Petroleum Institute
 - 3. NFPA – National Fire Protection Association

1.04 QUALITY ASSURANCE

- A. Fuel Oil System Supplier shall have at least 10 years of experience in the design, manufacture, and installation of fuel oil pumping, piping, monitoring and control systems and provide references for at least five similar sized installations in the last five years.
- B. The Fuel Oil System Design Shall be Signed and Sealed by a licensed professional engineer.

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer a complete, project-specific submittal including the following:
 - 1. Shop Drawings of all major components showing assembly, accessories and installation details
 - 2. Complete Bill of Materials.

3. Scaled piping layout drawings showing length of pipe runs, pipe sizes, support spacing and expansion provisions signed and sealed by a licensed professional engineer.
4. Control cabinet layouts.
5. Sequence of Operations.
6. Electrical wiring diagrams.
7. Catalog Data.
8. Proof of Product Liability Insurance.
9. Reports of Certified Shop and Field Tests
10. Operation and Maintenance Manuals for the Complete System and all components.
11. Manufacturer's Field Start-up Reports

1.06 FACTORY TESTING

- A. Prior to shipment, the manufacturer shall test all "Packaged" assemblies. A copy of the test procedures shall be sent to the consulting engineer and owner. The owners and/or the consulting engineer at their discretion shall observe this and all other tests.
- B. Electrical components shall be functionally tested with all instruments and controls. Settings of all instruments and controls shall be verified for conformance to these specifications. A certificate of factory testing, together with a copy of the wiring diagram shall be placed in the control cabinet prior to shipment. The UL-508 label shall be affixed to the inside of the cabinet.
- C. Pump Sets shall be fully tested prior to shipment. Testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set shall be brought to a vacuum greater than 25"Hg. The test shall confirm that the pump set piping system can maintain vacuum for 4 hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested.

PART 2 – PRODUCTS

2.01 MAIN FUEL STORAGE TANK

- A. Acceptable manufacturers
 1. Highland
 2. Modern Welding
 3. Containment Solutions
- B. General
 1. Provide and install an aboveground steel fuel oil storage tank manufactured in accordance with UL Standards 142. The tank and its containment shall be listed as an assembly by Underwriters Laboratories. The primary tank shall have a nominal volume of 6,000 US gallons as shown.

C. Design Criteria

1. Primary Tank: The primary tank shall be minimum 10 gauge carbon steel approved per U.L. 142 and meeting the requirements of NFPA 30. The tank shall be warranted for 25 years by the manufacturer.
2. Secondary Containment with Leak Monitoring: The secondary steel tank containment shall provide at minimum 100% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier.
3. The tank shall be rated for atmospheric pressure and shall be tested to 5 PSIG at the factory. Tank shall be suitable for other test/design pressure as required by local jurisdiction.
4. Provide tank with all necessary support and mounting systems. Tank Manufacturer shall provide recommendations on required anchor bolt size, number, mounting location and embedment depth.
5. Tank shall be factory primed and painted in accordance with the following:
 - a. Primer: Tnemec Series V69 Hi-Build Epoxoline; Carboline Carboguard 890 LT; or Sherwin Williams Macropoxy HS: One coat, 4.0 to 6.0 dry mils.
 - b. Touch up: Tnemec Series V69 Hi-Build Epoxoline; Carboline Carboguard 890 LT; or Sherwin Williams Macropoxy HS: One coat, 4.0 to 6.0 dry mils.
 - c. Finish: Tnemec Series 1080 Endura Shield WB; Carboline Carbothane 134 VOC; or Sherwin Williams Centurion WB Urethane: Two coats, 2.0 to 3.0 dry mils.

D. Tank Connections

1. Main Tank shall be provided with the following minimum connections:
 - a. Main Tank Fuel Fill (2")
 - 1) Fuel fill shall be supplied with factory installed drop tubes to prevent surging and foaming in the main tank.
 - b. Transfer Pump Suction (1")
 - 1) Tank shall be supplied with factory installed drop tube within 4" from bottom of tank.
 - c. Day Tank and Transfer Pump Relief Common Return (2")
 - d. Fuel Level Transmitter (4" Flange)
 - e. High Level Alarm Probe (1 1/4" FNPT)
 - f. Interstitial Space Rupture Containment Monitoring Point (1")
 - 1) Fuel shall be allowed to mitigate to a centralized monitoring location where a leak detection probe shall be installed.
 - g. Primary Vent
 - h. Emergency Vent
 - i. Additional Connections as required per Local, State, and Federal Code

E. Vent Protector(s)

1. Fuel oil storage Tank Vent Protector shall be the full size of the vent pipe or in accordance with NFPA 30 flammable and combustible liquids code and NFPA 31 standard for the installation of oil-burning equipment. It shall be of aluminum construction and provided with standard pipe threads. A standard Tank Vent Protector for each tank vent shall be furnished.

F. Main Tank Supply Pump Anti-Syphon Valve

1. Provide a UL listed Anti-Siphon Valve at the high point of the oil suction line on both the main supply and return pump supply lines. Anti-Siphon Valve body material shall be bronze. The valve shall be factory set to meet the flow and vertical pipe height requirements of the system. The valve shall be a Preferred Utilities Mfg. Corp. Danbury, CT, Model BGA-291Z1333 Anti-Siphon Valve, or equal.
- G. Main Tank Supply Pump Single Poppet Foot Valve
1. Provide a single poppet foot valve on the tank suction stub. Valve shall be bronze construction, with lapped-in seats, flat poppets and 20 mesh monel screen. The valve shall be a Preferred Utilities Mfg. Corp. Model 13062 Single Poppet 1" Foot Valve, or equal
- H. Main Tank Mechanical Overfill Preventer
1. The tank shall have an overfill prevention valve installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 6" of the tank bottom. Valve shall be fit for gravity only. The Overfill Prevention Valve shall be a Preferred Utilities Mfg. Corp. Danbury, CT Model 71L, or equal.
- I. Main Tank Overfill Alarm
1. The main fuel storage tank(s) shall be equipped with an audible/visual overfill alarm station. The overfill alarm station shall be initiated by a supplied main tank integrated overfill alarm switch and/or TG-EL-D4 Fuel Sentry tank gauging system integrated into the fuel oil transfer system. The main tank overfill alarm system shall consist of a NEMA 4 rated weather-proof cabinet and includes a 4" weather-proof alarm bell with automatic silencing, 180 degree visible flashing alarm light, alarm silence pushbutton and alarm reset pushbutton as well as a clear English language Fil-A-Larm sign to alert fuel transfer personnel of station. The bell shall be automatically silenced in 90 seconds or instantly when the operator selects the Alarm Silence button. Main Tank Overfill Alarm Station shall be Preferred Utilities Mfg. Corp. Model FA-AV-1D3, or equal.
 2. Provide Overfill Caution Sign near the Overfill Alarm Station. The sign shall be 20"W by 14"H of 18 gauge steel with porcelain baked enamel finished bright yellow background and minimum 2" H black lettering. The Caution Sign shall read: CAUTION WHEN ALARM BELL SOUNDS OIL TANK FILLED TO CAPACITY DO NOT OVERFILL. Sign shall be a Preferred Utilities Mfg. Corp., Fil-A-Larm Sign Model FA-S, or equal
- J. Main Tank Overfill Alarm Switch
1. Main Tank shall be fitted with a Preferred PLS- HLS high level oil switch. High Level Switch shall be arranged to activate the overfill alarm at the fuel oil transfer pump control panel when the liquid level reaches 90 percent of tank capacity. Pump running circuit of the return pump(s) shall be interlocked with the High Level Switch at the Fuel Oil Transfer Control Panel, which shall provide electronic instructions to shut off all pumps in the system if a return pump is the source of the overfilling, or alarm only if the cause is due to a delivery filling error. Tank High Level Switch Unit shall be float operated, suitable for #2 oil at 150 psi, have brass and Buna N wetted parts, and be mounted in a 1-1/4" tapping in the tank top. Switch shall be hermetically sealed and fully isolated from tank contents

and external atmosphere. Electrical connections shall be made externally to the tank in an explosion-proof head assembly approved by UL for Class 1, Group D applications. Switch shall be as manufactured by Preferred Utilities Mfg. Corp. Model: PLS-HLS, or equal

K. Access Ladder and Platform

1. Tank Manufacturer shall provide an OSHA compliant stairway and access platform as shown. Materials of construction shall be galvanized steel or aluminum.

2.02 MAIN TANK GAUGING AND LEAK MONITORING SYSTEM

A. Acceptable manufacturers:

1. Preferred Utilities Mfg. Corp.
2. Tidel Engineering, Inc.
3. Andover Controls/Schneider Electric

B. General

1. Provide a main storage tank monitoring system capable of monitoring level and sensing leaks in a single 6000 US Gallon UL-142 main tank and the associated piping integral to the Fuel Oil Transfer Pump System.

C. Tank Level Transmitter

1. The system shall include a probe capable of detecting the fuel level in the tank. Provide a float type level sensor to provide accurate level monitoring that is unaffected by changes in the specific gravity of the tank liquid, and is suitable for use with non-corrosive fluids and fuels up to and including No. 6 fuel oil. The level sensor shall consist of a NEMA 6P rated, ¼" cast aluminum head, connected to a float assembly by a flexible stainless-steel cable. The sensor head assembly shall mount to the tank through a standard 4" 125/150 lb. flat face flange opening, with standard bolt pattern and shall be capable of operating in an outdoor environment without damage. The unit shall be capable of easy installation and maintenance. The unit shall be able to be mounted, stand, and be subsequently removed for service with only 14" of clearance between the flange and any overhead obstructions. The sensor's operation shall be unaffected by internal tank obstructions located outside of a 14" diameter cylinder extending from the top of the tank to the bottom, and centered on sensor's mount. Tank gauge calibration shall be possible at any tank fluid level (empty, part full or full). The sensor shall include an external test mechanism to allow overfill alarm and full tank calibration checks without removal of the sensor from the tank. Tests that electronically simulate a high tank level, instead of physically moving the float, are not acceptable. The level transmitter shall be Preferred Utilities Mfg. Corp. Model TG-EL-WF-12CBWG-Z1333.

D. Monitoring Panel

1. Provide an integral microprocessor-based tank gauging, leak detection, and overfill prevention system per NFPA 30 Flammable and Combustible Liquids Code, NFPA 31 Standard for the Installation of Oil-Burning Equipment, and NFPA 110 Standard for Emergency and Standby Power Systems. The tank gauge shall be provided complete with RS485 Modbus interface to the BAS for each storage tank indicated on the drawings. The indicator, level sensors, leak sensors, and overfill alarm shall be supplied by one manufacturer. The indicator

and sensors shall be intrinsically safe for Class 1, Division 1, Group D hazardous locations as defined by the National Electric Code. The monitoring panel shall display the tank volume in gallons. The panel shall indicate alarm conditions for fuel high level, fuel low level, and tank leak. The indicator shall have a bright 4" bargraph display that is clearly visible from 20 foot viewing distance and shall be able to monitor either 1 or 2 tanks. All sensors signals shall be either 4-20 mA or contact closure for easy interchangeability of field devices. All leak sensors shall be automatically tested by the indicator on a daily basis with the result shown on the display.

2. Continuous sensor wiring fault detection (open or shorted) shall be provided. The system shall be field upgradeable to dual sensors for higher accuracy delivery reporting and/or density shift detection in the event that delivery 'shorting' is suspected. Provide idle tank theft alarming capability for standby tanks or emergency generator tanks as required.
3. The system shall be fully field configurable. The system shall be able to automatically generate a stick chart based on measured delivery flow and measured level if an accurate stick chart is not available for the tank.
4. Monitoring panel shall be integrated and supplied within the fuel oil transfer system control panel rated for NEMA 4 exposure.

E. Leak Detection

1. Provide and install leak detectors in the annular space within the rupture basin. The leak detectors shall be solid state and discriminate between oil and water, display the leak with (2) LED's on its indicating transmitter, and send an appropriate alarm signal to the Tank Gauge. All leak detectors shall be intrinsically safe, have continuous electronic checking, fail safe to an alarm condition, and have indicating transmitters with a magnetic test mechanism at grade level to exercise the sensors and check the Tank Gauge response. The leak detector shall be Preferred Utilities Mfg. Corp. Model HD-A2-CBWG-Z1333, or equal.
2. Provide a leak detector sensor guard to prevent against mechanical damage and exposure to high ambient infrared light. Leak detector guard shall be Preferred Utilities Mfg. Corp. Model HD-HSG, or equal.

2.03 SUPPLY FUEL OIL PUMP AND STRAINING SET

A. Acceptable Manufacturers subject to compliance with the specifications:

1. Preferred Utilities Mfg. Corp.
2. Viking Pump
3. IMO Pump

B. System

1. Provide and install a factory assembled "Packaged" Supply Automatic Fuel Oil Transfer and Monitoring System to ensure a reliable supply of fuel oil from one 6000-gal main tank to the emergency generator sub-base tank. System to be factory fabricated/tested and certified as a complete unit. Preferred Utilities Mfg. Corp. Model ATPSF-105BWG-1333-208-50- D-DP-TG1 or equal.
2. The system shall include automatic pump set lead/lag, storage tank and day tank level monitoring, leak monitoring, LCD operator touchscreen display, manual

back-up stations, time and date stamped alarm and event summary. The control system shall be a microprocessor based design with expansion capabilities.

C. Positive Displacement Pumps

1. The pump set shall include two (2) positive displacement internal gear rotary type pumps, with cast iron housing and self-adjusting mechanical, carbon ring seals. The pump shall be capable of developing 25" Hg. Vacuum at 0 PSIG discharge pressure as factory tested. However, for normal operation, vacuum shall not exceed 15" Hg. Pump and motor combination to be rigidly, direct mounted to ASTM-A36 channel.

D. Duplex Pump and Motor Assembly

1. Duplex Supply Oil pump and motor assemblies shall be factory assembled with components piped and mounted on a common base plate. Pipe shall be schedule 40 ASTM A-53 Grade "A" with ANSI B16.3 Class 150 malleable iron threaded fittings. Base plate shall include minimum 3" steel side rails, and be continuously welded out of minimum 1/4" plate steel for containment. Base pan assembly shall have inverted steel channel supports welded to the bottom of the base pan for anchoring. Provide a 1/2" containment basin plugged drain connection. The basin shall also be sized to contain potential leaks from all factory installed piping and components. The Automatic Fuel Oil Transfer Pump and Straining Set shall be Preferred Utilities Mfg. Corp, Danbury, CT Model 105BGZ1333 rated at 282 GPH (Diesel) and against a discharge pressure of 50 PSI.
2. The pumps shall be connected to the piping on the set through stainless steel flexible metallic braided jackets, and the pump and motor assemblies shall be welded to the base plate. Pumps and motors shall be mounted on an ASTM-A36 structural steel channel and equipped with flexible coupling and full OSHA approved coupling guard. Pumps and motors shall be mounted with bolts threaded into the steel channel for ease of maintenance. Mounting bolts shall not penetrate the secondary containment basin.

E. Motors

1. The supply pump set shall include two (2) TEFC, rigid base, standard NEMA frame motors. Motors sized to develop no less than 3/4 HP at 1725 RPM using 208 V, 3 Ph, 60 Hz electrical service. Motor shall have copper windings; a dynamically balanced rotor, ball bearings and a heavy gauge steel NEMA frame.

F. Pump Isolation and Check Valves

1. Each pump set shall include four (4) pump isolation valves located on the suction and discharge side of each pump. Isolation valves shall allow off-line pump maintenance without system loss of availability. Isolation valves shall be ball type, rated 600 WOG, include stainless steel ball and Teflon seat. Valves to provide full flow while open and positive shutoff when closed. Additionally, two (2) class 125 # swing check valves shall be included, one (1) located on the discharge of each pump. Valves to have a re-grindable bronze seat and a threaded cap.

G. Fuel Oil Strainer

1. Each pump set shall include one (1) factory installed duplex strainer, basin mounted, on the suction side of the pumps. Strainer to be sized for less than 1/2

psi of mercury drop through a clean strainer basket with the maximum anticipated flow in the suction line. Strainer shall be one-piece cast iron body and shall be suitable for 200 psi. Strainer baskets shall be 40-mesh stainless steel. Strainer shall come complete with lever wrench handle and be bolted in place without bolting through pan. Strainer shall be Preferred Model 72-BG-1-1333, or equal.

2. Strainer shall be equipped with a factory mounted and wired differential pressure switch to indicate that the basket needs to be cleaned. Indicating scale plate shall be three-position color-coded for easy indication of strainer basket flow status. Switch shall provide indication on the main pump set control cabinet to alert operators

H. Relief Valves

1. Each pump set shall include a relief valve downstream of each pump sized to relieve the full outlet flow of the pump without causing the pump motor to overload or any component's pressure rating to be exceeded if the discharge is inadvertently valved off. Relief valves shall be externally mounted from the pumps and piped to the return line in the field according to NFPA 30. Pump internal relief valves shall not be accepted. Relief valves shall be Preferred Model R, or equal.

I. Compound and Pressure Gauges

1. Each pump set shall include a compound gauge on the common suction header feeding the pumps. The gauge shall read 30" vacuum -15 psig. A second pressure gauge shall be included on the discharge side of each pump and shall read 0-100psig. Each gauge shall be equipped with an isolation ball valve.

J. Pump Containment Leak Detection Switch

1. Provide a factory mounted and wired, intrinsically safe, containment basin leak detector to shut off the pumps and energize an audible and visual alarm should a leak be detected. Leak sensor shall be mounted within the pump basin. Electrical connections shall be contained in a factory installed weatherproof junction box.

K. Pump Set Control Cabinet

1. Provide two fuel oil management stainless steel control enclosures factory mounted on the fuel oil pump set. One cabinet shall include all the motor voltage components and shall include a disconnect switch that shall be opened before the enclosure door can be opened. The other enclosure shall house the low voltage (120V or less) control hardware. The control cabinets shall be completely pre-wired and factory programmed and tested to ensure job site reliability. Provide a factory assembled NEMA 4X rated stainless steel enclosure with operator interface touchscreen, manual back-up control switches and indicators mounted on the door.
2. Each Pump set control cabinet panel shall include an audible alarm during all alarm conditions.

L. PLC Based Control System

1. The fuel oil transfer control panel shall be a PLC based control panel. Communications with the Day Tank Control Panel shall be through Ethernet TCP/IP communications or another protocol as approved by the Engineer. Devices mounted in close proximity to each controller shall be hard-wired to the controller's analog inputs, analog outputs, digital inputs, or relay outputs. If any controller, or node, in the network shuts down or stops communicating, an alarm shall sound and the other controllers shall continue to operate. The control system logic and calibration data shall be stored in a non-volatile memory that does not require battery backup.
 2. Each microprocessor controller shall include, but not be limited to, the following inputs and outputs:
 - a. (24) 120 VAC digital inputs
 - b. (5) 2 A relay outputs
 - c. (5) 1/2 HP (10 A) relay outputs
 - d. (8) loop-powered 4-20 mA analog inputs
 - e. (3) 4-20 mA analog outputs
 3. The main transfer pump system microprocessor controller shall be equipped with a 10" color touchscreen Operating Interface Terminal (OIT). The network connection and OIT connections shall be designed and configured such that one spare connection port is available for system troubleshooting from a laptop computer. The touchscreens shall be pre-programmed at the factory with graphic pages for operation, setup, trouble-shooting, and alarm indication. Each touchscreen shall be capable of displaying information from any of the controllers in the control system.
 4. Interface to Plant SCADA
 - a. The following dry contact outputs shall be provided at the fuel oil transfer control panel to the existing plant control system:
 - 1) Common Alarm (for Generator)
 - 2) Common Alarm (for SCADA)
 - 3) Storage Tank – Low Level
- M. Alarm and event Logs
1. The control system shall include a 200 alarms, events and operator actions memory minimum. Provide an alarm display page for viewing the most recent 8 alarms/events with scrolling capability to view the complete 200-point alarm/event memory. Each event and alarm condition shall be displayed with a distinct, descriptive, English language description and time and date stamp. New alarms shall trigger the common alarm output relay. Events shall be recorded, but shall not trigger an alarm. A dedicated alarm silence button shall silence the alarm output. The control system shall record and annunciate the following alarms: Pump Thermal Overload, Pump Loss Of Flow, Pump Set Failure, Pump Containment leak, Day Tank (1) Leak, Day Tank (1) High level, Day Tank (1) Low level, Main Tank High, Main Tank Low Level, Main Tank leak. The control

system shall record the following events: Pump Started, Pump Control Switch in "Off" position and Pump Selected as Lead.

N. Fuel Pump Alternation and Lead-Lag Operation

1. Provide automatic, microprocessor-based day tank level control on the supply pump system. The lead fuel pump shall be energized when Day Tank oil level falls below the Supply Pump On Level (50% full condition). The lead pump shall continue to operate until the day tank level reaches the Supply Pump Off Level (80% full condition). Upon the next call for fuel, the lead pump shall be automatically alternated. The control system shall automatically energize the back-up pump upon detecting a low level condition (40% full condition). Both pumps shall then continue to operate until the level of oil reaches the Supply Pump Off level (80% full condition). Upon detection of loss of flow or lead pump thermal overload the control system shall automatically energize the backup pump and de-energize the lead pump. Should the level reach the High Level (90% full condition), then both supply pumps shall be disabled and the system shall activate an alarm.

O. Pump Automatic Sequencing Flow Switch

1. Provide a time delayed flow sensing switch on the discharge of the pump set to bring on the lag pump should the lead pump fail to maintain flow. Flow switch shall be vane operated to actuate a single double throw snap switch. Switch shall be ship loose for alarm and backup pump operation. Switch shall be rated for 1450 psig. Provide a flow switch outlet isolation valve for maintaining the flow switch without draining the fuel system.

P. Enclosure

1. The fuel oil transfer system as a whole and complete skid package shall be installed and contained within the confines of a NEMA 4 Rated enclosure. Enclosure shall contain two 1500 watt, thermostatic controlled heaters. Piping contained permeating through the enclosure shall be installed with appropriate boot assemblies. Enclosure shall have an oil and chemical resistant finish to ensure longevity.

Q. Factory Testing

1. Pump Sets shall be fully tested prior to shipment as follows: testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set shall be brought to a vacuum greater than 25"Hg. The test shall confirm that the pump set piping system can maintain vacuum for 4 hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested. A copy of the test procedures shall be sent to the Engineer and Owner. The Owner and/or the Engineer, at their discretion, shall observe this and all other tests. A certificate of factory testing, together with a copy of the wiring and arrangement diagrams shall be placed in the control cabinet prior to shipment.

2.04 GENERATOR SUB-BASE DAY STORAGE CONTROL AND LEAK MONITORING SYSTEM

- A. Acceptable manufacturers subject to compliance with the specifications:
 - 1. Preferred Utilities Mfg. Corp.
 - 2. Tidel Engineering, Inc.
 - 3. Andover Controls/Schneider Electric
- B. General
 - 1. Provide a main storage tank monitoring system capable of monitoring level and sensing leaks in a single 200-gallon UL-142 double wall steel aboveground horizontal generator sub-base day tank and the associated piping.
- C. Generator Sub-base Day Storage Tank Required Accessory Connections
 - 1. Generator sub-base Day Tank shall be provided with the following minimum connections:
 - a. Day Tank Fuel Fill (1") From Transfer Pump System.
 - 1) Fuel fill shall be supplied with factory installed drop tubes to prevent surging and foaming in the main tank.
 - b. Generator Suction (Size Per Generator Supplier)
 - 1) Tank Shall be Supplied with factory installed drop tube within 4" from bottom of tank.
 - c. Generator Discharge (Size Per Generator Supplier)
 - d. Fuel Level Transmitter (2" NPT)
 - e. Pump On/Off Level Control Probe (1 1/4" FNPT)
 - f. Pump High/Low Level Control Probe (1 1/4" FNPT)
 - g. Interstitial Space Rupture Containment Monitoring Point (1")
 - 1) Fuel shall be allowed to mitigate to a centralized monitoring location where a leak detection probe shall be installed.
 - h. Primary Vent
 - i. Emergency Vent
 - j. Additional Connections as required per Local, State, and Federal Code
- D. Day Tank Controller and Monitoring Panel
 - 1. Supply a microprocessor based control panel for the monitoring of the Day Tank instruments and control devices. The unit shall communicate with the fuel transfer pump control panel as described in the preceding paragraph.
 - 2. The Day Tank control panel shall be equipped with a 4" color touchscreen Operating Interface Terminal (OIT). The touchscreen communicates to the controller via RS-485 Modbus protocol. The touchscreens shall be pre-programmed at the factory with graphic pages for operation, setup, troubleshooting, and alarm indication. Each touchscreen shall be capable of displaying information from any of the controllers in the control system.
 - 3. Monitoring and control panel shall be supplied and installed within the generator enclosure.
- E. Tank Level Control
 - 1. Level control shall be provided for one (1) total generator set day tank.
 - 2. Each generator day tank shall be supplied with day tank level fill controls and leak detection. Accessories for level control and leak detection shall be supplied

by the fuel oil handling system manufacturer for seamless integration and assured operation.

3. Level Control Probe(s)
 - a. The tank level control shall be two (2) Model PLS-1333-BWG-2 as manufactured by Preferred Utilities Mfg. Corp. Danbury, CT. Control shall be float operated, installed through and threaded each into one (1) 1¼" tapping on the top of the tank, shall be suitable for pressures up to 150 PSIG and temperatures up to 180°F and shall be entirely of nonferrous material with 2 each Buna-N switches each rated at 100 watts.
4. The level control probes shall provide contacts for pump on, pump off, day tank low, day tank high and provide signals for alarming and control with the supplied fuel oil transfer pump system.

F. Tank Level Transmitter

1. The system shall include a probe capable of detecting the fuel level in the tank. Provide a float type level sensor to provide accurate level monitoring that is unaffected by changes in the specific gravity of the tank liquid, and is suitable for use with non-corrosive fluids and diesel fuel oil. The unit shall be capable of easy installation and maintenance. The sensor's operation shall be unaffected by internal tank obstructions located outside of a 4" diameter cylinder extending from the top of the tank to the bottom, and centered on sensor's mount. Tank gauge calibration shall be possible at any tank fluid level (empty, part full or full). The level transmitter shall be Preferred Utilities Mfg. Corp. Model CL-TBDBWG-1333, or equal.

G. Leak Detection

1. Provide and install leak detectors in the annular space within the double wall tank (the piping sump and/or floor or vault below the storage tank as shown on the drawing). The leak detectors shall be solid state and discriminate between oil and water, display the leak with (2) LED's on its indicating transmitter, and send an appropriate alarm signal to the Tank Gauge. All leak detectors shall be intrinsically safe, have continuous electronic checking, fail safe to an alarm condition, and have indicating transmitters with a magnetic test mechanism at grade level to exercise the sensors and check the Tank Gauge response. Tests that bypass the sensors or rely only on electronic simulation are unacceptable. The leak detector shall be Preferred Utilities Mfg. Corp. Model HD-A2-CBWG-1333.
2. Provide a leak detector sensor guard to prevent against mechanical damage and exposure to high ambient infrared light. Leak detector guard shall be Preferred Utilities Mfg. Corp. Model HD-HSG, or equal.

H. Manufacturer

1. Tank gauging and leak detection system shall be Preferred Utilities Mfg. Corp. Model DT-FSCZ1333 or equal

2.05 FUEL OIL PIPING

A. General Piping

1. Black Iron Pipe
 - a. Reference, ANSI B36.10 and ANSI B125.1.

- b. Type: Seamless black iron pipe.
 - c. Weight: Schedule 40.
 - d. Finish: Black
 - e. End Finish: Plain.
 - 2. Fittings:
 - a. Socket Weld:
 - b. Reference: ANSI B16.3.
 - c. Type: Malleable iron.
- B. Provide metal braided flexible fuel oil piping with threaded ends on pump suction And discharge connections and at generator sub base tank connections and where required. Flexible pipe shall be manufactured by Titeflex Industrial Americas, or equal.
- C. Provide containment system for all piping. Containment pipe shall have a hot dipped galvanized coating or Min 20 mil Fusion bonded epoxy coating. Containment system shall be manufactured by Rovanco Piping Systems or equal.

2.06 FUEL OIL ACCESSORIES

- A. Emergency Shut Off Valves
1. Provide a fusible link lever gate valve, or valves as indicated, with an automatic fuel shut-off limit switch assembly. Switch assembly shall be wired to the main pump set control panel to provide "fire" and "loss of fuel Supply" alarms and provide interlock with fuel oil pump set operation (shutting off pump).
 2. Install one fusible link lever gate valve on the supply line of each day tank. Day tank controller shall monitor the lever gate valve and alarm and shut off the fuel supply to this day tank in the event of a fire. The valves shall be a Preferred Utilities Mfg. Corp. Danbury, CT, Model BG110Z1333-S Fire Safety Shut Off Valve, or equal.
- B. Vent Caps and Spill Container
1. Fuel oil storage Tank Vent Protector shall be the full size of the vent pipe or in accordance with NFPA 30 flammable and combustible liquids code and NFPA 31 standard for the installation of oil-burning equipment. It shall be of aluminum construction and provided with standard pipe threads. A standard Tank Vent Protector shall be furnished.
 2. Provide a spill container on the tank fill line.

2.07 HANGERS AND SUPPORTS

- A. Hangers and supports shall be constructed of 304 stainless steel

PART 3 - EXECUTION

3.01 INSTALATION

- A. General:
1. Install all items as shown, specified, and as recommended by the manufacturer.
 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.

3. Present conflicts between piping systems and/or equipment and/or structures to ENGINEER, in writing, who will determine corrective measures to be taken.
 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 5. Installation to conform to requirements of all local and state codes.
 6. Provide dielectric couplings between dissimilar metals.
 7. Protection: Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
- B. Piping:
1. All fuel oil supply and return piping above the storage tank shall sloped back to the tank.
 2. Install vertical pipe truly plumb in all directions.
 3. Install piping parallel or perpendicular to building walls. Piping at odd angles and 45 degree runs across corners will not be accepted, unless specifically shown.
 4. Provide temporary caps or plugs over all pipe openings at the end of eachday's Work, or when otherwise required or directed, to prevent foreign material from entering the piping systems.

3.02 START-UP, COMMISSIONING AND TRAINING

- A. Manufacturer's Services
1. The Contractor shall provide the services of the manufacturer's certified technician to monitor the installation, start-up, test, and calibrate the equipment. The manufacturer's technician shall also provide training. The fuel handling system as a whole shall be functionally tested. All instrument settings shall be verified for conformance to these specifications.
- B. Commissioning and Training
1. Provide a minimum of One (1) day(s) of factory certified service for the startup and certification of the fuel oil handling system. Provide for one (8) hour training session in the proper operation and maintenance of the equipment. Training sessions shall cover the operation, troubleshooting and maintenance of the fuel handling equipment.

-END OF SECTION-

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Contractor shall provide instrumentation and control system as as may be described and as necessary for a complete and operating system. A pre-qualified instrumentation subcontractor is not required.
- C. The electrical scope of work for this project primarily includes, but is not limited to, the following:
 1. Demolish existing generator and related components as described on the Drawings.
 2. Furnish a new diesel standby generator sized to power the upgraded pumping requirements for the Pump Station.
 3. Furnish and install panelboards and other low voltage electrical power distribution equipment.
 4. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.
 5. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.
 6. Furnish and install all low voltage wire and cable resulting in a complete and operable electrical system.
 7. Furnish and install new lighting systems and wiring devices.

8. Other electrical work as specified herein and indicated on the Drawings.
- D. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.
 - E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.
 - F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
 - G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

- B. The contractor shall coordinate with the Utility for scheduling of Utility power shutdowns as may be required to complete the work on the existing standby power system.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Operation and Maintenance Manuals
 - 3. Spare Parts List
 - 4. Proposed Testing Methods and Reports of Certified Shop Tests.
 - 5. Reports of Certified Field Tests.
 - 6. Manufacturer's Representative's Certification.
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.

1.05 APPLICABLE CODES AND REQUIREMENTS

- A. Conformance
 - 1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:
 - a. Insurance Rating Organization having jurisdiction
 - b. The serving electrical utility company
 - c. The currently adopted edition of the National Electrical Code (NEC)
 - d. The National Electric Manufacturers Association (NEMA)
 - e. The Institute of Electrical and Electronic Engineers (IEEE)
 - f. The Insulated Cable Engineers Association (ICEA)
 - g. The American Society of Testing Materials (ASTM)
 - h. The American National Standards Institute (ANSI)

- i. The requirements of the Occupational Safety Hazards Act (OSHA)
 - j. The National Electrical Contractors Association (NECA) Standard of Installation
 - k. National Fire Protection Association (NFPA)
 - l. International Electrical Testing Association (NETA)
 - m. All other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.
- B. Nonconformance
1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.
- C. Certification
1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section 01510, Temporary Utilities.

1.08 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.

- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. Refer to each individual specification section for detailed test requirements.
- D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

1.09 INFRARED INSPECTION

- A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations.
- B. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor.
- C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.
- D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment

manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.

- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.11 POWER SYSTEM STUDIES

- A. The Contractor shall provide power systems studies performed by a registered professional engineer in accordance with Section 16055 – Power System Studies.
- B. The Power System Study, and the related protective device adjustments, shall encompass both new and existing electrical equipment.

1.12 SCHEDULES AND FACILITY OPERATIONS

- A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.

- C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.
- D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference Section 01520 of the Specifications for construction sequencing and specific operational constraint information.

1.13 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

1.14 WARRANTIES

- A. Warranty requirements may be added to or modified in the individual equipment specifications.
- B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the thirty day operational period after the equipment startup. If the equipment does not perform satisfactorily during the thirty day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.
- C. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.

- D. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.

1.15 TRAINING

- A. Unless otherwise specified in an individual specification section, training shall be performed by a qualified trainer as described below.
- B. The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational.
- C. The Contractor shall have submitted, and had accepted, the O&M Manuals prior to commencement of training.
- D. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary. The Contractor shall provide professional video taping of all training sessions. Completed, labeled tapes shall be provided to the Owner for each type of training session.

PART 2 -- PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

- A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may, at his option use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.
- B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.
- C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 -- EXECUTION

3.01 CUTTING AND PATCHING

- A. Coordination
 - 1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.
- B. Damage
 - 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of

damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- END OF SECTION -

SECTION 16055

POWER SYSTEM STUDIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide Short Circuit Studies, Equipment Evaluation Studies, Protective Device Coordination Studies, Load Flow Analyses, and Arc Flash Hazard Studies performed by a professional electrical engineer currently registered in the Commonwealth of Virginia.
- B. The scope of work for these studies shall include the electrical distribution system for the Raw Water Pumping Station. Equipment shall include, but not be limited to, the new generator and overcurrent protection devices, the existing main disconnect and automatic transfer switch, existing switchboard RWPS, existing power panel PP-RWPS, existing lighting panel LP-RWPS, the existing Travelling Screen Control Panel, the four (4) Raw Water Pump controller enclosures.

1.02 REFERENCE CODES AND STANDARDS

- A. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. Standard 141, Recommended Practice for Electrical Power Distribution for Industrial Plants
 - 2. Standard 241, Recommended Practice for Electrical Power Systems in Commercial Buildings
 - 3. Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Systems
 - 4. Standard 399, Recommended Practice for Industrial and Commercial Power System Analysis
 - 5. Standard 519-1992, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
 - 6. Standard 1584-2002/2004a, IEEE Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
2. Standard C37.91, Guide for Protective Relay Applications to Power Transformers
3. Standard C37.95, Guide for Protective Relaying of Utility-Consumer Interconnections.
4. Standard C37.96, Guide for AC Motor Protection
5. Standard C57.12.59, Guide Dry-Type Transformer Through-Fault Current Duration
6. Standard C.57.13, Standard Requirements for Instrumentation Transformers
7. Standard C57.109, Guide for Liquid-Immersed Transformer Through Fault-Current Duration

C. National Electrical Code (NEC)

D. National Fire Protection Agency (NFPA):

1. NFPA 70E, Standard for Electrical Safety in the Workplace (2018)

1.03 SUBMITTALS

- A. The Contractor shall submit for review and approval, four (4) paper copies and one (1) electronic copy of the Power System Studies Report.
- B. All Reports shall bear the signature and seal of the professional electrical engineer that performed the study.

1.04 QUALIFICATIONS

- A. The Power System Studies shall be performed by a professional electrical engineer registered in the Commonwealth of Virginia. The registered professional electrical engineer shall have a minimum of five (5) years of experience in performing power systems studies.
- B. The resume of the registered professional electrical engineer shall be submitted for approval prior to the start of work. An experience table shall also be provided detailing the power systems studies of similar scope to this Contract that have been performed by the proposed engineer over the last two (2) years. The table shall, at a minimum, list the facility owner's name, facility contact person with phone number and email address, and overall scope of work that was provided.

PART 2 -- PRODUCTS

2.01 POWER SYSTEM STUDIES

A. General

1. The Contractor shall provide Short Circuit Studies, Equipment Evaluation Studies, Protective Device Coordination Studies, Load Flow Analyses, and Arc Flash Hazard Studies for the entire electrical system. The studies shall be performed in accordance with IEEE 399, Recommended Practice for Industrial and Commercial System Power Analysis (IEEE Brown Book).
2. The studies shall include all portions of the electrical distribution system from the serving electric utility company protective devices, the normal and standby power sources down to and including the 208 volt equipment. The studies shall include all low voltage switchgear, motor control centers (MCCs), Variable Frequency Drives (VFDs) and panelboards as shown on the Drawings. System connections and those which result in maximum fault conditions shall be adequately covered in the study.
3. The studies shall be performed with the aid of SKM Systems Analysis Power Tools for Windows (PTW) software, Version 8 or newer. No other software analysis packages are acceptable.

B. Data Collection for the Studies

1. The Contractor shall collect all required utility transformer and service information for use in these studies.
2. One (1) field visit to the project site to collect pertinent data from existing equipment by the personnel performing the studies is permitted. The visit shall span as many days as required to collect all necessary information. This visit shall occur as soon after the Contract is awarded as possible and shall be coordinated with the County. The Contractor and personnel performing these studies are responsible for collecting all required data for these studies.

C. Short Circuit Studies

1. The short circuit study shall be performed in accordance with the latest editions of IEEE Std. 399 and IEEE Std. 141.
2. The study input data shall include the serving electric utility company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.
3. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each bus, low voltage switchgear, low voltage motor control center, distribution panelboard, pertinent branch circuit panel and other significant locations through the system. The

short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

4. The short circuit study report shall include recommendations for equipment selection based on calculated short circuit values and all input and output data from the software model.

D. Equipment Evaluation Studies

1. An equipment evaluation study shall be performed to determine the adequacy of both existing and proposed circuit breakers, panelboards, motor control centers, automatic transfer switches, busses, etc. located at the plant by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. A table shall be provided in the report showing the calculated fault currents and the corresponding short circuit ratings of the existing equipment.

E. Protective Device Coordination Studies

1. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings.
2. The coordination study shall include all low voltage classes of equipment from the serving electric utility company service protective devices down to and including all adjustable circuit protective devices. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.
3. The time-current characteristics of the proposed protective devices shall be printed on a log-log scale. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.
4. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current

transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings.

F. Load Flow Analyses

1. A load-flow analysis shall be performed to determine the steady-state loading profile of the plant. The analysis shall be based on both the serving electric utility as a source and the standby generator as a source. From the results of the load flow analysis, the report shall indicate areas of overloaded conductors or equipment in the power distribution system design.
2. The report shall also include a total source load summary table, as well as single line diagrams showing only the load flow data.
3. Load flow analysis results shall also be presented in a tabular format in the report.

G. Arc Flash Hazard Studies

1. An Arc Flash Hazard Study shall be performed in accordance with IEEE Std. 1584, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S.
2. The Arc Flash Hazard Study Report shall include but not be limited to the following:
 - a. An executive summary outlining the electrical distribution system
 - b. A brief overview of what arc flash hazards are and how to avoid them.
 - c. Serving electric utility information received. Copies of the information received shall be included in an appendix.
 - d. All assumptions made to complete the report
 - e. Definitions of key terms used in the report
 - f. Any recommendations to reduce the arc flash incident energies where they are found to exceed a 12 cal/cm².
 - g. A PPE table that defines the Personnel Protective Equipment (PPE) classes and clothing descriptions identified in the report and labels.
 - h. Arc flash hazard warning labels as specified herein.
 - i. An NFPA 70E energized work permit for each location where a warning label is provided.
 - j. Arc flash evaluation summary sheets as specified herein
 - k. Separate set of single line diagrams that show incident energies, hazard risk categories, and protective device settings. Only pertinent arc flash

hazard data shall be displayed on these single line diagrams. Data from all other study calculations shall not be shown.

3. The following parameters shall be used in the Arc Flash Hazard Study:
 - a. Working distance for all equipment: 18”
 - b. Maximum arc duration for all equipment: 2 seconds
 - c. Incident energies, arc flash hazard boundaries, and hazard risk categories shall be calculated over a $\pm 15\%$ of calculated arcing fault current. The worst case incident energies that result shall be used in the study report.
 - d. The equipment that connects to both the electric utility service and the standby power is in an open-transition configuration. The power sources will be incapable of paralleling with each other.
 - e. The arc flash analysis shall be performed as if the facility is being supplied by either of the electric utilities **and** as if the facility is being supplied by the standby generators. The worst case values from each calculation shall be used in the study report.

4. Arc Flash Warning Labels shall be produced for each location that allows access to energized parts. Labels shall be printed in color on adhesive backed labels. Labels shall be an ANSI Z535.4 compliant (minimum size 4 in. x 6 in.) thermal transfer type label. For incident energy values of less than 40 cal/cm², the labels shall have an orange colored header with the word “WARNING”. For incident energy values equal to and above 40 cal/cm², the labels shall have a red colored header with the word “DANGER”. Each label shall include the following information:
 - a. Bus name
 - b. System operating voltage
 - c. Date of issue
 - d. Flash hazard protection boundary
 - e. Limited approach boundary
 - f. Restricted boundary
 - g. Prohibited boundary
 - h. Incident energy level
 - i. Required personal protective equipment level

5. Arc Flash Evaluation Summary Sheets shall be produced. All values shown on the Summary Sheets shall be commensurate with the values shown on the single line diagrams. Summary sheets shall list the following:
 - a. Bus name
 - b. Upstream protective device name and protective device settings
 - c. Bus line-to-line voltage
 - d. Bus bolted fault
 - e. Protective device bolted fault current
 - f. Arcing fault current
 - g. Protective device trip / delay time
 - h. Breaker opening time
 - i. Solidly grounded column
 - j. Equipment type
 - k. Gap
 - l. Arc flash boundary
 - m. Working distance
 - n. Incident energy
 - o. Required personal protective equipment level

2.02 Study Reports

- A. Reports shall be furnished in the quantities specified herein, neatly organized into properly identified 3" (minimum) 3-ring binders. Tabs shall clearly separate each section of the report. Each report shall begin with a table of contents. The following sections shall be included in the report as a minimum:
 1. Executive Summary
 2. Short Circuit Study
 3. Equipment Evaluations
 4. Protective Device Coordination Study

- 5 Load Flow Analysis
- 6. Arc Flash Study
- C. All data used in the reports such as conductor sizes and lengths, motor sizes, utility contribution information, and the like shall be included in the appendices of the report.
- D. All single line diagrams and time current curves shall be provided in the reports on 11x17 paper, properly folded to fit into the report binder. Use of standard 8.5x11 paper for these purposes is not permitted. Single line diagrams shall be appropriately split up between several sheets (if required) to allow the drawing scale to be adjusted in order to make text and symbols legible.

PART 3 – EXECUTION

3.01 FIELD ADJUSTMENT

- A. Contractor shall adjust all relay and protective device settings according to the recommended settings table provided in the approved Report.
- B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

3.02 ARC FLASH LABELS

- A Contractor shall place approved adhesive arc flash labels on equipment after the Final Report is reviewed and approved.

3.03 TRAINING

- A. The Contractor shall train the County's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

- END OF SECTION -

SECTION 16111

CONDUIT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.
- B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 16190, Electrical Supporting Devices, for these requirements.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI B1.20.1 – Pipe Threads, General Purpose
 - b. ANSI C80.1 – Electrical Rigid Steel Conduit
 - c. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - d. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - 2. Underwriters Laboratories (UL)
 - a. UL 1 – Standard for Flexible Metal Conduit
 - b. UL 6 - Electrical Rigid Metal Conduit-Steel
 - c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel
 - d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit
 - e. UL 467 – Grounding and Bonding Equipment
 - f. UL 514B – Conduit, Tubing, and Cable Fittings

- g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings
 - h. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations
 - i. UL 1479 – Standard for Fire Tests of Penetration Fire Stops
 - j. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit
 - 3. National Electrical Manufacturer’s Association (NEMA)
 - a. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit
 - b. NEMA TC-2 – Electrical PVC Conduit
 - c. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing
- B. Others
 - 1. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for conduits and fittings.
 - 2. Conduit identification methods and materials.
 - 3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

- A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:
 - 1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.
 - 2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.
- B. Conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:
 - 1. P – Power Conduit
 - 2. C – Control Conduit

PART 2 – PRODUCTS

2.01 GENERAL

- A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.
- B. All metallic conduit fittings shall be UL 514B and UL 467 Listed, and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.
- C. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.
- D. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.
- E. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to $\frac{3}{4}$ inch of expansion/contraction along the axis of the conduit as well as up to $\frac{3}{4}$ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.
- F. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.
- G. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for all other areas shall be provided with covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of electro-galvanized malleable alloy and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.
3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.
2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.
3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.
2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.
3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN-1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS – PARAGRAPH NOT USED

2.06 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.
2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.
2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment, and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

2.07 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.08 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.09 ELECTRICAL METALLIC TUBING (EMT)– PARAGRAPH NOT USED

2.10 CONDUIT BENDS

- A. Rigid conduit bends, both factory fabricated and field fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

- B. Conduit bend radii for standard radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

- C. Conduit bend radii for long radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.11 MISCELLANEOUS

- A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:
 - a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.
 - b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within

buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.

2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:
 - a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.
 - b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.
 - c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.
2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, 1/2 inch wide, with a minimum tensile strength of 1250 lbs.

2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull, and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

- A. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.
- B. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.
- C. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.
- D. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.
- E. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.
- F. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be 3/4 inch per foot tapered threads in accordance with ANSI B1.20.1.
- G. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.
- H. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.
- I. Where non-metallic control conduits containing shielded cables are installed exposed, the following clearances to other conduit types shall be maintained:
 1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.

2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.
 3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.
 4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.
- J. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.
- K. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.
- L. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the Engineer. Liquid containment areas are indicated on the Drawings.
- M. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs.
- N. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.
- O. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.
- P. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit $\frac{1}{4}$ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

3.02 CONCEALED AND EMBEDDED CONDUITS

- A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:
1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.
 2. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible.

3. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.
 4. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.
- B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:
1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.
 2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division I and Division II).
 3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/ SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in indoor wet process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in indoor dry process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in outdoor areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Exposed within pre-fabricated electrical equipment center buildings	Electrical Metallic Tubing	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	Choose an item.
Concealed within non-elevated (i.e. "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit

RIGID CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/ SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit	PVC coated rigid galvanized steel conduit	Same as Power and Control

2. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:
 - a. All 90 degree bends or combinations of adjacent bends that form a 90 degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.
2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.
3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.
4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:
 - a. All conduits containing medium voltage cable.
 - b. All conduits containing fiber optic cable.
 - c. All conduits containing shielded VFD cable.
 - d. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:

- a. Connections to motors and engine-generator sets (and similar vibrating equipment)
 - b. Connections to solenoid valves and limit switches
 - c. Connections to lighting fixtures installed in suspended ceilings
 - d. Connections to lighting transformers
 - e. Connections to pre-fabricated equipment skids
 - f. Connections to HVAC equipment
 - g. Connections to instrument transmitters and elements
 - h. Where specifically indicated in the Standard Details
2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in indoor wet process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Flexible metal conduit	Same as Power and Control
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings (all indoor areas)	Same material as exposed conduit in same area	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.
2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.
2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.
2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:
 - a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.
 - b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.
2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the locknut.
3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.
2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.
3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

3.06 CONDUIT IDENTIFICATION

- A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:
 1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word "TO:" and the text in the 'TO' column of the conduit and wire schedule (e.g. TO: Main Pump No. 1). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word "FROM:" and the text in the 'FROM' column of the conduit and wire schedule (e.g. FROM: MCC-SPS). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.
 3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18 point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24 point font.
 4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.

5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.
 6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.
- B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:
1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.
- C. Conduits for lighting and receptacle circuits shall not require identification.
- D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.07 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

- A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

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SECTION 16118

UNDERGROUND ELECTRICAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install underground duct systems, electric manholes, and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.
- B. The provisions of this Division are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other Contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.
- C. Reference Section 16000, Basic Electrical Requirements; Section 16111, Conduit; Section 16170, Grounding and Bonding; the applicable sections of Division 2, Sitework; Section 03200, Reinforcing Steel; and 03300, Cast-In-Place Concrete.

1.02 CODES AND STANDARDS

- A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. AASHTO H20
 - 2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to, the following:

1. Product data sheets.
2. Outline and dimensional drawings including detailed sections of the manholes and/or handholes.
3. Materials specifications and structural calculations for the manholes sealed by a Professional Engineer in the State of Virginia.

1.05 IDENTIFICATION

A. Each electric manhole and handhole cover shall be lettered with the word "Electric", the manhole or handhole identification number (e.g. UMH-1, EMH-1, EHH-1, etc.), manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

2.02 DUCT SYSTEM

- A. The underground duct system shall be comprised of conduits, conduit bends, and conduit fittings as specified in Section 16111, Conduit. Conduits shall be encased in reinforced concrete envelopes, unless otherwise specified herein or indicated on the Drawings.
- B. Base and intermediate conduit spacers shall be furnished to provide a minimum of two-inch (2") separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4" conduit spacer shall not be used to secure a 2" conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or equal.

2.03 ELECTRIC MANHOLES

- A. The concrete manholes shall be complete with metal frames and covers of size and location as specified herein and shown on the Drawings.
- B. Manhole frames and covers shall be Neenah R-1640C1, or equal, with Type A anchor ring. Entire manhole assembly shall be AASHTO H20 heavy duty rated.
- C. All electric manholes shall be provided with non-metallic cable racks. Cable racks shall be rated for the application, with a minimum loading capacity of 450lbs per rack arm.

Cable rack system shall be Heavy Duty type as manufactured by Underground Devices, Incorporated or equal.

2.04 ELECTRIC HANDHOLES

- A. The electric handholes shall be a precast polymer concrete enclosure suitable for use as part of an underground electric raceway system. The enclosure shall meet or exceed the requirements of ANSI/SCTE 77-2010.
- B. The enclosure and cover design and test load rating shall be Tier 15. Covers shall be provided with cover hooks.
- C. The enclosure shall be the straight side design to allow easy adjustment of box to grade. The box shall be stackable for increased depth.
- D. Handhole opening size shall be as required to suit the application, 6" X 8", minimum.
- E. The electric handholes shall be manufactured by Hubbell, Pencil Plastics equivalent, Highline Products equivalent, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The underground duct system, manholes, and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers' instructions.

3.02 DUCT SYSTEM

- A. All underground conduit shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the standard details. Concrete shall be furnished and installed in accordance with Section 03300. Reinforcing steel shall be furnished and installed in accordance with Section 03200.
- B. Concrete pours shall be complete from handhole to handhole and from manhole to manhole where practicable. Partial pours in general shall not be permitted. Where a complete pour is impractical, written authorization shall be obtained from the Engineer for the partial pour.
- C. Conduit ductbank elevations at the manholes and handholes shall be based on minimum ductbank cover as indicated in the standard details, or deeper to avoid conflicts with other obstacles][maintained as shown on the Drawings. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.
- D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3" per 100' unless otherwise indicated on the Drawings.

- E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the standard details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.
- F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.
- G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.
- H. A minimum of one (1) ground rod, furnished in accordance with Section 16170, shall be driven adjacent to each manhole, handhole, or other concrete box. A No. 4/0 AWG bare copper ground cable shall be connected between this rod and the copper ground strap using a silicon bronze connector. All ground rods shall be interconnected by means of the No. 4/0 AWG bare copper ground cable located within each duct bank. The ends of these cables shall also be connected to substation and/or building ground buses where the conduits terminate.
- I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer's instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.
- J. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.
- K. Construct concrete-encased conduits connecting to underground structures to have a flared section adjacent to the manhole to provide shear strength. Construct underground structures to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.
- L. Six (6) inches above all duct banks, the Contractor shall furnish and install a two (2) inch wide red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters: "ELECTRIC LINE BURIED BELOW." Tape shall be Detectable Identoline by Brady, or equal.
- M. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading and restoration of surfaces and seeded areas disturbed during the execution of the work.

- N. All conduit joints in the duct system shall be staggered such that adjacent conduits do not have joints in the same location.

3.03 ELECTRIC MANHOLES

- A. Electric manholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 14" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to the roof. All manholes shall be built on, or placed over a 6" layer of well-tamped gravel.
- B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.
- C. All concrete work and fully assembled manholes shall be completely watertight and shall be furnished with sloped floors that pitch towards a sump pit. The outside surfaces shall be coated with an approved asphaltic waterproofing compound (all sides, bottom, and roof). Precast concrete manholes may be installed; however, all requirements of this section and other divisions of the Specifications and the details shown on the Drawings shall apply.
- D. Install pulling eye irons imbedded in walls opposite each duct entrance securely fastened to manhole reinforcing rods. All hardware shall be hot-dipped galvanized steel. Copper bars shall be provided in the walls for grounding. No. 4/0 AWG bare copper cables shall be connected to these bars and all non-current carrying metal parts shall be grounded to these copper bars.
- E. All cables shall be well supported on walls by nonmetallic cable racks. The cable racks shall be heavy-duty type for medium and low voltage power cables and light duty type for control, signal, communications and similar small conductors. All racks shall be rigidly attached to the wall and equipped with adjustable rack arms.

3.04 ELECTRIC HANDHOLES

- A. Electric handholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 9" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to roof. All handholes shall be built on, or placed over a 6" layer of well-tamped gravel.
- B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.
- C. All fully assembled handholes shall be completely watertight.
- D. All individual cables and/or bundles of conductors shall be identified and "dressed" along the wall of the enclosure. Cable racks as specified herein shall be provided if any handhole dimension exceeds 24 inches.

3.05 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field tests

- a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.
- b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

- END OF SECTION -

SECTION 16123

LOW VOLTAGE WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.
- B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.
- C. Reference Section 16000 – Basic Electrical Requirements and Section 16130 – Boxes.

1.02 CODES AND STANDARDS

- A. Low voltage wire, cable, and appurtenances shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. Underwriters Laboratories (UL)
 - a. UL 13 – Standard for Power-Limited Circuit Cables
 - b. UL 44 – Thermoset-Insulated Wires and Cables
 - c. UL 83 – Thermoplastic-Insulated Wires and Cables
 - d. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 - e. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords
 - f. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
 - g. UL 2250 – Standard for Instrumentation Tray Cable
 - h. UL 2556 – Wire and Cable Test Methods
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire
 - b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

- c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
 - d. ASTM D69 – Standard Test Methods for Friction Tapes
 - e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
3. Insulated Cable Engineers Association (ICEA)
- a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification
 - b. ICEA T-29-250 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour
4. Institute of Electrical and Electronics Engineers (IEEE)
- a. IEEE 1202 – Standard for Flame Testing of Cables

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300 – Submittals, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of Field Tests
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for wire and cable, terminations, and pulling lubricant.
 - 2. Cable pulling calculations (if required).
 - 3. Wiring identification methods and materials.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar

information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 CABLE PULLING CALCULATIONS

- A. Prior to the installation of the wire and cable specified herein, the Contractor shall submit cable pulling calculations for engineer review and approval when all of the following are true:
 - 1. The amount of cable to be installed will be greater than 200 linear feet between pull points.
 - 2. The installation will have one or more bends.
 - 3. The wire and cable is size #1/0 AWG and larger.
- B. Cable pulling calculations shall be performed by a currently registered professional engineer in the Commonwealth of Virginia and shall define pulling tension and sidewall loading (sidewall bearing pressure values).

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.

2.02 POWER AND CONTROL WIRE AND CABLE

- A. Power wire installed between the output terminals of a VFD and the respective motor shall consist of insulated copper conductors. Conductor insulation shall be rated for 90°C in both wet and dry locations, and 600V. Insulated conductors shall be UL 44 Listed as NEC Type XHHW-2.
- B. Power wire for all other loads and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.
- C. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size. Power conductors for lighting and receptacle branch circuits shall be solid copper per ASTM B-3.

- D. Power conductor size shall be no smaller than No. 12 AWG and Control conductor size shall be no smaller than No. 14 AWG.
- E. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- F. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or equal.

2.03 INSTRUMENTATION CABLE

- A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e. groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e. group shields) and an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.
- D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.
- E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.
- F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

2.04 SHIELDED VFD CABLE - PARAGRAPH NOT USED.

2.05 CONDUCTOR IDENTIFICATION

- A. Conductors shall be identified using a color coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:
 - 1. 480/277V AC Power
 - a. Phase A - BROWN

- b. Phase B - ORANGE
 - c. Phase C - YELLOW
 - d. Neutral – GREY
 - 2. 120/208V or 120/240V AC Power
 - a. Phase A - BLACK
 - b. Phase B - RED
 - c. Phase C - BLUE
 - d. Neutral - WHITE
 - 3. DC Power
 - a. Positive Lead - RED
 - b. Negative Lead - BLACK
 - 4. DC Control
 - a. All wiring - BLUE
 - 5. 120VAC Control
 - a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock. This interlock conductor shall be color coded YELLOW. For the purposes of this Section, an interlock is defined as any wiring that brings voltage into the above mentioned equipment from a source outside that equipment.
 - 6. 24 VAC Control
 - a. All wiring - ORANGE
 - 7. Equipment Grounding Conductor
 - a. All wiring - GREEN
- B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.
- C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part

3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

2.06 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 -- EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. General

1. Wire and Cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.
2. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.
3. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
4. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power or control wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.
2. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.
3. No splicing of instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.

D. Additional Conductor Identification

1. In addition to the color coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.
2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.
3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.
5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-

conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.
2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:
 - a. 18 inches for 480/277VAC wiring
 - b. 12 inches for 208/120VAC wiring
 - c. 6 inches for 24VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 16130 – Boxes, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.
3. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

4. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
5. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

3.02 FIBER OPTIC CABLE INSTALLATION – PARAGRAPH NOT USED

3.03 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Shop Test
 - a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.
 2. Field Tests
 - a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
 - b. After installation, some wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
 - i. For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for one (1) minute . Resistance shall be no less than 100 Megohms. Insulation testing is not required for power and control cables smaller than #8 AWG.
 - ii. Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megohms or greater.

- B. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.
- C. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.
- D. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. ____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AWG MCM Shield:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: ____ Pothead ____ Terminal					Location: Indoors____ Outdoors____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. _____

Part Tested:		Test Performed: _____ Hours/Days: _____ After Shutdown: _____					
Grounding Time:		Dry Bulb Temperature: _____ Wet Bulb Temperature: _____					
Test Voltage:		Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____					
Megohmmeter:		Serial Number: _____		Range: _____		Voltage: _____	
		Calibration Date: _____					
Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
1/4 Minute				5 Minutes			
1/2 Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minute Ratio			
Remarks:							

- END OF SECTION -

SECTION 16130

BOXES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.
- C. Reference Section 16000, Basic Electrical Requirements, and Section 16111, Conduit.

1.02 CODES AND STANDARDS

- A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 514A - Metallic Outlet Boxes
 - 2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
 - 3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - 4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations
 - 5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
- B. Shop Drawings
- C. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.
- B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. PPB-XXX, CJB-YYY) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 16195, Electrical – Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

- A. General
 - 1. All pull and junction boxes shall be UL listed and labeled.
 - 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
 - 3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.

4. Where metallic boxes are used they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.
2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.
2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.
3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring

- b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring
4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.
 5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.
 6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 16141, Wiring Devices, for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.
2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Cast Aluminum
Indoor Dry Process Area	NEMA 1, Cast Aluminum
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Cast Aluminum
All Outdoor Areas	NEMA 4X, PVC Coated Steel

4. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable, however, concentric and eccentric knockouts are not acceptable.
2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.
3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.

4. Outlet boxes mounted cast into concrete shall be concrete tight, and shall be made of galvanized steel or PVC.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 16111, Conduit, for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.

5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - a. Light switches and wall mounted occupancy sensors, 48 inches
 - b. Receptacles in indoor dry process/non-process areas, 16 inches
 - c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches
 - d. Receptacles in outdoor locations, 24 inches
 - e. Ceiling mounted occupancy sensors, as indicated on the Drawings
6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

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SECTION 16170

GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:
- D. Reference Section 16000, Basic Electrical Requirements

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 467 – Grounding and Bonding Equipment
 - 2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - 3. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.

- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.
- B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

2.06 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
 - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.

2. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtailed" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system. The copper pigtailed shall be exothermically welded to the ground grid, and connected to building reinforcement steel by hydraulic crimp.
3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
6. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Witnessed Shop Tests
 - a. None required.
 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.
 - b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer

review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

- c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

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SECTION 16190
SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 4. ASTM A276 – Standard Specification for Steel Bars and Shapes
 - 5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop drawings

2. Structural support calculations (if required)

B. Each submittal shall be identified by the applicable Specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

A. Support channel shall be 1-5/8" by 1-5/8" minimum, with 12 gage material thickness.

B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Hot Dipped Galvanized Steel
Indoor Dry Non-process Area	Hot Dipped Galvanized Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

- C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Type 304 Stainless Steel
Indoor Dry Non-process Area	Type 304 Stainless Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.

2. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.
3. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
4. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.
5. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.
6. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
7. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; he shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
8. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
9. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the State of Virginia.
10. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the State of Virginia.
 - a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.
 - b. A quantity of eight (8) or more conduits trade sizes 1 1/2" to 2 1/2" are proposed for a conduit support rack.
 - c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.

11. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

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SECTION 16195

ELECTRICAL - IDENTIFICATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull/junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, black with white lettering.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section 16111, Conduit.

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 16123, and Building Wire and Cable.
- B. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

PART 3 -- EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four

(4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

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SECTION 16470

PANELBOARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install panelboards of voltage and current ratings as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming to the panelboard schedules on the Drawings.
- B. Reference Section 16000, Basic Electrical Requirements; Section 16195, and Electrical Identification.

1.02 CODES AND STANDARDS

- A. Panelboards shall be designed, manufactured, and/or listed to the following standards as applicable:
 1. Underwriters Laboratories
 - a. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - b. UL 67 – Standard for Panelboards
 - c. UL 489 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures
 - d. UL 943 – Ground Fault Circuit Interrupters
 2. NEMA PB1 - Panelboards
 3. National Electrical Contractors Association (NECA) Standard 407 – Standard for Installing and Maintaining Panelboards

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 1. Shop Drawings.
 2. Spare Parts List.
 3. Operation and Maintenance Manuals.
 4. Reports of Field Tests.

- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard.
 - 3. Complete panelboard schedules indicating circuit designations as shown on the Drawings for each panelboard.
 - 4. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings.

1.05 OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1. The manuals shall include:
 - 1. Instruction books and/or leaflets.
 - 2. Recommended spare parts list.
 - 3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and during field installation.

1.06 SPARE PARTS

- A. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer. All spaces in the panelboards shall be furnished with a spare breaker as indicated in the panelboard schedules shown on the Drawings.
- B. Spare parts lists shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.07 IDENTIFICATION

- A. Each panelboard shall be identified with the identification name/number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each panelboard. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 CONDUCTORS (MAIN BUS AND BRANCH CONNECTORS)

- A. All main bus shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above a maximum ambient temperature of 40 degrees C.

2.03 LIGHTING PANELBOARDS

A. General

1. Lighting panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal-overload, branch circuit breakers. Panelboards shall be of the configuration and rating as specified herein and indicated on the Drawings. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Lighting panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers, as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.
3. Lighting panelboards shall be fully rated and shall have a minimum short circuit rating of 22,000 amperes symmetrical, unless otherwise indicated on the Drawings.
4. Lighting panelboards shall be Eaton Pow-R-Line Series, the Square D Company equivalent, the General Electric Company equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall be UL 50 listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed

of No. 12 U.S.S. code gauge galvanized steel, painted ANSI #61 light gray. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep.

2. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim.
3. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars are required and neutral bus ampacity shall be the same as the main bus bars unless otherwise noted. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type and UL 489 Listed. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Tandem or half-size circuit breakers are not acceptable.
2. Where indicated on the Drawings, or where required by Code, circuit breakers shall be equipped with integrally mounted ground fault interrupters complete with "TEST" push button and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. Ground fault circuit interrupter style circuit breakers shall be UL 943 Listed. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD".

Where required by Article 440 of the NEC, circuit breakers installed for air conditioning units shall be HACR type.

3. Circuit breaker voltage ratings shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 240 VAC that matches the panelboard short circuit rating.
4. Main circuit breakers shall be individually mounted. Branch mounted circuit breakers are not acceptable unless specifically indicated on the panel schedules. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location.
5. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlockable hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the packlock is removed. Branch circuit breakers shall be provided with a similar lock-on device where indicated on the Drawings.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.04 POWER DISTRIBUTION PANELBOARDS

A. General

1. Power distribution panelboards shall be of the configuration and rating as specified herein and as indicated on the Drawings. The panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal overload branch circuit breakers. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Power panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.
3. Power distribution panelboards shall be fully rated and shall have a minimum short circuit rating of 65,000 amperes symmetrical unless otherwise indicated on the Drawings.

4. Power distribution panelboards shall be Eaton Pow-R-Line Series, the Square D Company equivalent, the General Electric Company equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall be UL 50 listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed of No. 12 U.S.S. code gauge galvanized steel, painted ANSI #61 light gray. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep.
2. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim.
3. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1,000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars, where required, shall be provided. Neutral bus shall have the same ampacity as the main bus, unless otherwise indicated. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces. Panelboards Listed and Labeled as a four-wire panel shall not be used in place of a three-wire panel where a neutral conductor does not exist in the supply conductors to that panel.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type and UL 489 Listed. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation.
2. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD" where required by Article 440 by the NEC. Circuit breakers installed for air conditioning units shall be HACR type.
3. Circuit breaker voltage rating shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A, unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 480 VAC that matches the panelboard short circuit rating.
4. Main circuit breakers shall be individually mounted. Branch mounted circuit breakers are not acceptable unless specifically indicated on the panel schedules. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location.
5. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlockable hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the packlock is removed. Branch circuit breakers shall be provided with a similar lock-on device where indicated on the Drawings.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be provided in each panel. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.05 SURGE PROTECTIVE DEVICES

- A. The panelboards shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings. SPD shall be installed within the panelboard enclosure in a location that allows the required quantity and rating of branch circuit breakers to be installed. Reducing the quantity of branch circuit breakers to less than that required by the panel schedules is not acceptable.
- B. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, latest edition.
- C. The SPD shall be factory installed by the panelboard manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.

- D. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the panelboard. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.
- E. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the panelboard. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V
480 DELTA	N/A	1200V	2000V	N/A
240 DELTA	N/A	1200V	1200V	N/A
120/240	700V	700V	1200V	700V

- F. The Nominal Discharge Current (In) of the SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
- G. The surge current rating for each SPD shall be 100kA unless otherwise indicated on the Drawings.
- H. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

- I. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.
- J. The SPD equipment shall be SPD Series by Eaton, SurgeLogic by the Square D Company, Tranquell by the General Electric Company, Siemens Energy and Automation Inc. equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer, and as required by NECA 407.

- B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six (6) feet above finished floor elevation.
- C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.
- D. The Contractor shall not use factory furnished knockouts with surface mounted back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush mounted back boxes with manufacturer's standard pattern of knockouts.
- E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush mounted enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.
- F. Bus loads in all panelboards shall be balanced between phases to within a tolerance of one (1) KVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practical.
- G. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Field Tests
 - a. Prior to termination of any conductors to the circuit breakers , all bus work and circuit breakers shall be tested from phase to phase and phase to ground with a 1000 VDC megaohmmeter for 1 minute in accordance with NECA 407. Resistance values shall be recorded and shall not be less than 100 megohms.
 - b. Prior to terminating any wires to the circuit breakers, the resistance of the connection between the bus work and each circuit breaker shall be tested through the use of a low-resistance ohmmeter. Record the resistance values for each circuit breaker.

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SECTION 16620

PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install a standby power engine generator set complete with base-mounted day tank, storage tank, fuel transfer pumps, leak detection systems, piping, exhaust silencer, batteries, charger, enclosure, and devices for automatic and manual control.
- B. It is the intent under this Contract to require an installation complete in every detail whether or not indicated on the Drawings or specified. Consequently, the Contractor is responsible for all details, devices, accessories and special construction necessary to properly install, adjust, test, and place in successful and continuous operation the engine-generator set.
- C. Use materials which are new, unused, and as specified, or, if not specifically indicated, the best and most suitable of their kinds for the purpose intended, and for the design and expected conditions of service, subject to the approval of the Engineer.
- D. Provide workmanship that is first class in every respect. Employ workers thoroughly experienced in such work. A neat and workmanlike appearance in the finished work shall be required.
- E. All materials used must bear the inspection labels of the Underwriter's Laboratories, if the material is of a class inspected by the Laboratory.
- F. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- G. The engine generator sets shall fully comply with all current Environmental Protection Agency (EPA) emission regulations including, but not limited to, the New Source Performance Standards (NSPS) for stationary and non-road generator sets. The engine generator set(s) must meet the EPA new source performance requirements required at the time the engine generator set(s) submittal is approved by the engineer. Engines manufactured previous to the submittal approval date that do not meet the current regulated emissions levels are not acceptable.
- H. Reference Section 16000 - Basic Electrical Requirements, and Section 15480- Generator Fuel System.

1.02 CODES AND STANDARDS

- A. The packaged engine-generator system shall comply with the following Codes and Standards as a minimum:
1. NEMA MG1, Motors and Generators.
 2. NEMA MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Motors and Generators.
 3. ISO STD 8528, Reciprocating Internal Combustion Engines.
 4. ISO STD 3046, Performance Standard for Reciprocating Internal Combustion Engines.
 5. NFPA 30, Flammable and Combustible Liquids Code.
 6. NFPA 37, Standard for Installation and use of Stationary Combustible Engine and Gas Turbines.
 7. NFPA 70, National Electrical Code
 8. NFPA 70E, Standard for Electrical Safety in the Workplace
 9. NFPA 110, Standard for Emergency and Standby Power Systems.
 10. UL 508, Industrial Control Equipment.
 11. EGSA, Electrical Generating Systems Association.
 12. UL 2200 – Stationary Engine Generator Assemblies
 13. ANSI C57, Dry-Type Transformers.
 14. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
 15. UL 1236 – Standard for Battery Chargers for Charging Engine Starter Batteries.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
1. Shop Drawings
 2. Spare Parts List
 3. Reports of Certified Shop and Field Tests
 4. Operation and Maintenance Manuals

5. Manufacturer's Field Start-up Report
6. Manufacturer's Representative's Installation Certification

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings for each engine-generator set shall include but not be limited to:
 1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this specification section.
 2. Manufacturers printed specification sheets showing critical engine and generator set specifications including the following:
 - Dimensions, and weights
 - Guaranteed fuel consumption at 25%, 50%, 75% and 100% of full rated load
 - Engine bhp available
 - Brake Mean Effective Pressure (BMEP)
 - Engine jacket water heat rejection
 - Exhaust flow rate and temperature at 100% of rated load
 - Ventilation and combustion air requirements
 - Exhaust backpressure limitation
 - Liquid refill capacities
 - Voltage regulation characteristics
 - Guaranteed noise levels

3. Alternator technical electrical data, including, but not limited to:
 - Alternator efficiency at 50%, 75%, and 100% load
 - Telephone Interference Factor (TIF)
 - Harmonic waveform distortion
 - Type of winding insulation and generator temperature rise
 - Per unit subtransient impedance X'' and X/R ratios for positive, negative, and zero sequences
 - Transient reactance (X_d')
 - Synchronous reactance (X_d)
 - Sub transient time constant (T_d'')
 - Transient time constant (T_d)
 - DC time constant (T_{dc})
 - Decrement curve
4. Manufacturer's printed warranty statement of the engine and generator set showing single source responsibility by the engine manufacturer.
5. Generator control panel equipment and features. Include a written explanation of the auto start/stop logic and operation.
6. Engine-generator set and accessory product data sheets including, but not limited to, the following:
 - Alternator strip heater
 - Radiator
 - Seismically rated vibration isolators
 - Flexible exhaust coupling
 - Exhaust silencer
 - Batteries
 - Battery charger
 - Engine manufacturers shutdown contactors
 - Jacket coolant heater
 - Fuel cooler
 - Fuel tank(s) and pump(s)
 - Fuel level devices
 - Output circuit breaker and trip unit
 - Conduit
 - Wire and Cable
 - Wiring Devices
 - Lighting
 - Panelboards

7. Standard dealer preventative maintenance contract for review and possible adoption under a separate contract. Dealer must have existing contracts and personnel and contractual detailed performance information available.
 8. Normal operating ranges for systems temperature, pressure and speed.
 9. Manufacturer's part number for the engine and generator operation guide, parts book, service manual, warranty policy, and installation guide.
 10. Location of other similar units showing compliance with the experience requirements specified herein.
 11. Phone numbers of twenty-four (24) hour products support contacts and locations.
 12. Drawing showing right hand, left hand, and top views of proposed assembly; battery rack, isolators, exhaust silencer, conduit stub up locations, and flexible fittings; wiring schematics, interconnection diagrams (point to point), and written description of engine generator controls and alarm circuits.
 13. Control panel layout drawings and wiring diagrams.
 14. Drawings and specifications for the diesel fuel tanks.
 15. EPA Certificate of Conformity for Exhaust Emissions
 16. Detailed drawings showing plan, front, and side views as well as appropriate section views of the weatherproof, engine-generator enclosure. Include product data sheets for all appurtenances (e.g. exhaust fan, thermostat, lighting, switches, receptacles, combination power unit, etc.) to be furnished and installed in the enclosure. Drawings shall be of sufficient detail to assure proper installation by the Contractor.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.
- 1.05 REPORTS OF CERTIFIED SHOP AND FIELD TESTS
- A. Submit two (2) certified copies of all test reports. This includes all shop tests and field tests. Certified shop test reports for prototype engine-generator sets are unacceptable. The manufacturer's serial number for the actual engine-generator set furnished for this project shall appear on all test reports.
- 1.06 OPERATION AND MAINTENANCE MANUALS
- A. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not more than 10 days after the equipment arrives on the project site.

- B. The preliminary manuals shall be reviewed by the Engineer prior to the Contractor submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Contractor with required revisions noted, or the acceptance of the Engineer noted.
- C. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts. Manuals shall contain all information submitted as part of the shop drawing review process.
- D. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contract information.
- E. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.
- F. Following the Engineer's review of the preliminary manuals, the Contractor shall submit five (5) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Owner. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents, as well as any changes made during installation. Failure of the final manuals to reflect the required revisions noted by the Engineer as well as changes made during installation will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not more than one (1) month after receipt of the Engineer's comments.

1.07 SPARE PARTS

- A. Routine maintenance and adjustments shall be performed without the use of special tools or instruments. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts for each engine-generator set:

<u>No. Required</u>	<u>Description</u>
1	Set of Fuel Oil Particulate Filters
1	Set of Air Filters
1	Set of Lube Oil Filters
1	Set of Fuel Oil/Water Separator Filters
1	Set of Coolant Filters

- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts list, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.
- F. The dealer shall have sufficient parts inventory to maintain over-the-counter availability of at least 90% of any required part and 100% availability within 48 hours.

1.08 IDENTIFICATION

- A. Each engine-generator set shall be identified with the identification name/number indicated on the Drawings (e.g., RWPS Generator, etc.). A nameplate shall be securely affixed in a conspicuous place on the generator main circuit breaker or output termination box enclosure. Nameplates shall be as specified in Section 16195, Electrical - Identification.

1.09 WARRANTY TERMS

- A. The manufacturer's and Dealer's warranty shall in no event be for a period of less than two (2) years or two-thousand (2,000) hours of operation, whichever comes first, from date of delivery of equipment to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, coolant, and other service items made unusable by the defect) used during the course of repair. Submittals received without written warranties as specified shall be rejected in their entirety.
- B. Provided warranty shall cover all equipment included in the scope of supply. This warranty shall include, but is not limited to, the following:
 - Engine-generator set and respective auxiliary equipment
 - All controls for the engine-generator set
- C. Batteries shall be provided with two (2) year full replacement guarantee, and a pro-rated

replacement schedule thereafter.

1.10 OIL SAMPLING KIT

- A. The generator set supplier shall provide an oil sampling analysis kit which operating personnel shall utilize for scheduled oil sampling. All equipment needed to take oil samples shall be provided in a kit and shall include the following:

1	Sample extraction gun
10	Bottles
10	Postage-paid mailers
1	Written instructions

An additional oil sampling kit shall be made available to the Owner to continue the sampling when the above specified kit has been depleted. All kits in addition to that specified above shall be at an additional cost to the Owner, if the Owner desires to continue the sampling service.

1.11 CONSTRUCTION SEQUENCING

- A. The Contractor shall reference Section 01520, Maintenance of Utility Operations During Construction, of these Specifications.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Consideration will be given only to the equipment of those manufacturers who have furnished comparable size diesel engine-generator sets for at least two similar installations that have been in regular successful operation for not less than five (5) years.
- C. The engine-generator set manufacturers shall be Cummins, MTU, or Caterpillar, no equal. The engine-generator set manufacturer and/or dealer shall be responsible for the entire engine-generator package including the engine-generator set with all accessories and equipment specified herein and all other devices required for a complete and operable system.

2.02 GENERAL DESCRIPTION

- A. The engine-generator set shall be rated as specified herein and as indicated on the Drawings. It shall have the capability to operate at its standby rating for the duration of any power outage with all accessories including engine running devices, silencer, radiator, cooling fans, fuel system, and all appurtenances complete as it would be installed in the field. The Contractor shall note and take appropriate action regarding the intended operation of the engine-generator sets while connected to motor driven loads controlled by variable frequency drives (VFDs).

2.03 ENGINE

- A. The engine shall be diesel, 4 cycle, radiator cooled, and shall be turbocharged having an operating speed of 1800 RPM. Engine shall operate on ASTM D-975 Grade No. 2D S15 ultra-low sulfur diesel fuel. Engines requiring any other fuel type are not acceptable.
- B. The engine will not be acceptable if the design is a conversion of a naturally aspirated engine to which a turbo-blower has been attached, unless the engine is certified by the manufacturer as having been analyzed and redesigned with ample provisions for increased stresses and bearing or heat loads due to increased pressures and rate of heat liberation.
- C. Break mean effective pressure (BMEP) shall not exceed 350 psi at rated load. Brake Horsepower (BHP), and Engine-Generator efficiency shall conform with ASME, IEEE and NEMA standards that electrical energy delivered by the machine is within the minimum certified guaranteed fuel oil consumption rate and evidence that these parameters have been met shall be furnished.
- D. Only engine manufacturers' standard ratings shall be acceptable. No dealer special ratings will be acceptable.
- E. The specified standby kW rating shall be for continuous electrical service during interruption of the normal utility source, per NEMA standards.
- F. Engine speeds shall be governed by an electronic isochronous governor that will sense generator speed and provide accurate load transient correction capability at less than 0.5 percent regulation, from no load to full load generator output.

2.04 ALTERNATOR

- A. The alternator shall conform to NEMA and IEEE standards and be rated as indicated on the Drawings. The alternator shall have a UL 2200 listing. The alternator shall be brushless, salient pole, 2/3 pole pitch and synchronous for operation at 480VAC, wye connected, as indicated on the Drawings. The generator shall be capable of delivering 1750 SkVA (minimum) at an instantaneous voltage dip of no more than 15% voltage drop.
- B. Laminations and windings shall be designed for minimum reactance, low voltage waveform distortion and maximum efficiency.
- C. The main stator coils shall random wound. Insulation shall be Class H, 125 Degree C rise according to NEMA standards. The insulation system shall be made of epoxies and polyesters which are inorganic compounds and shall prevent fungus growth.
- D. The rotor shall be dynamically balanced and include amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions.
- E. Radio interference suppression (both directions) shall be provided in accordance with NEMA and IEEE Standards.
- F. The alternator shall have a brushless, permanent magnet generator (PMG) excitation support system to provide input to the automatic voltage regulator to enable the alternator to support 300% of rated current for 10 seconds to allow fault clearing.

- G. Waveform deviation shall not exceed 5% from true sine wave. The transient response from no load to full load in one step of the engine-generator set shall not exceed a voltage dip of 35%, a frequency dip of 20%, and shall recover to complete steady state performance within 12 seconds for both voltage and frequency. The transient response from full load to no load in one step shall not exceed a voltage overshoot of 7% and shall recover to steady state performance within 3 seconds. Transient performance shall be in accordance with ISO 8528.
- H. The Telephone Influence Factor (TIF) shall be less than 50.
- I. The voltage regulator shall be an adjustable, solid-state, three-phase RMS sensing, volts/hertz type. Voltage regulation shall be a minimum of +/-0.25% from no load to continuous rating. The voltage regulator shall provide +/-10% voltage adjustment. The voltage regulator shall be located within the engine control panel.
- J. An alternator mounted strip heater shall be furnished and installed as part of the system. The strip heater shall be energized to prevent condensation when the engine generator set is not running.

2.05 CONTROLS

- A. Engine-generator monitoring and controls shall be mounted in a single NEMA 1 (gasketed) dust-tight enclosure. A suitable accessible terminal strip having all wires properly identified shall be furnished within the enclosure. The control panel shall be mounted at a height of 4'-8" measured from the center of the panel to the equipment pad or enclosure floor.
- B. The control panel shall accept a dry contact input for engine starting from remote locations. The starting and stopping of the engine-generator set shall be initiated through the control panel only. When the engine starts, starting control shall automatically disconnect cranking controls. Four (4) cranking cycles of 10 seconds "ON", 10 seconds "OFF" shall be provided. The starting controls shall prevent re-cranking for a definite time after source voltage has been reduced to a low value, or the four (4) cranking cycles have been reached without a successful start. The automatic engine starting controls shall use industrial rated control type elements throughout, and controls shall have the capability to operate at 50% battery voltage.
- C. Speed sensing shall be provided to protect against accidental starter engagement with a moving flywheel. Battery charging alternation output voltage is not acceptable for this purpose.
- D. A generator/exciter field circuit breaker with shunt trip device shall be furnished and installed as part of the engine generator set. Shunt trip shall be activated upon engine-generator fault conditions.
- E. A main line circuit breaker as specified herein and sized as indicated on the Drawings shall be installed as a load circuit interrupting and protection device in a NEMA 1 (gasketed) dust-tight enclosure. Main line circuit breakers shall be 100% rated unless otherwise indicated. The circuit breaker shall be provided with adjustable long-time, short-time, and instantaneous settings. The circuit breaker shall contain an electronic trip unit with ground fault. It shall operate both manually for normal operation and automatically for protection

against overload or short circuits. Generator/exciter field circuit breakers are not acceptable for this service.

The circuit-breakers described above shall be manufactured and tested in accordance with U.L. and NEMA AB1 standards. Their interrupting rating shall be suitable for the available fault current. All electrical ratings shall be suitable for the application.

- F. Engine-generator monitoring and control shall be provided using a microprocessor based control panel complete with an LCD display. The devices necessary for automatic starting shall be on the engine and in the engine control panel. The following hardware (minimum) shall be provided on the front of the control panel; the use of the LCD display and keypad to accomplish the same function is not acceptable:
1. Keyed engine control mode switch (Run-Off-Auto)
 2. Large, red emergency stop pushbutton
 3. Generator voltage adjust potentiometer
 4. Generator frequency adjust potentiometer
- G. The following parameters (minimum) shall be shown on the LCD display or otherwise be indicated at the control panel:
1. Engine oil pressure
 2. Coolant temperature
 3. Generator output voltage
 4. Generator output current
 5. Generator elapsed run time
 6. Generator output frequency
 7. Engine run
 8. Engine fail
 9. Low coolant temperature
 10. Pre-high engine temperature
 11. Pre-low fuel level
 12. Engine speed (RPM)
- H. The following events (minimum) shall cause an immediate shutdown of the engine-generator set if it operating, or prevent starting if it is not operating. The specific event that causes the

shutdown/prevents starting shall be shown on the LCD display or otherwise be indicated at the control panel. A reset shall be required to clear the fault and allow the unit to operate:

1. Engine coolant high temperature
 2. Engine low oil pressure
 3. Low fuel level
 4. Engine overspeed
 5. Engine overcrank
 6. Engine tried to start but failed
 7. Low coolant level
- I. The generator control panel shall have a communication port capable of transmitting all available to a remote annunciator display using a serial data protocol. The generator vendor shall supply 500 feet of their recommended network data communication to the Contractor for installation.
- J. The generator control panel shall have Form C dry contacts rated 5A (minimum) at 120VAC/24VDC for the following signals:
1. Engine coolant high temperature
 2. Engine low oil pressure
 3. Pre-low fuel level
 4. Low fuel level
 5. Engine overspeed
 6. Engine overcrank
 7. Engine tried to start but failed
 8. Low coolant level
 9. Engine fail
 10. Engine run
 11. Fuel System Failure
- K. Provide a Remote Annunciator Panel with indicating lamps displaying the alarm conditions in the previous paragraph. The remote annunciator shall be compatible with the main generator control panel and connect over a serial data cable. The Remote Alarm Panel shall

be equipped with 4 configurable form C dry contact outputs for interface with the existing plant PLC. Contacts shall be configured as shown below:

1. Main Generator – Common Failure.
2. Fuel System – Common Failure.

2.06 ENGINE ACCESSORIES

- A. Furnish and install the engine with all accessory equipment and appurtenances which are required for proper operation, including the following:
 1. Heavy duty dry type air filler with restriction indicator
 2. Heavy duty lubricating oil filter, bypass type, with replaceable absorbent-type elements
 3. Lubricating oil cooler, water cooled
 4. Heavy duty fuel oil filter, spin-on, with non-replaceable absorbent-type elements
 5. Fuel oil fuel/water separator
 6. Heavy duty crankcase vapor coalescer
 7. Radiator mounted fuel cooler to cool recirculated fuel before it is re-deposited into the fuel tank as recommended by the manufacturer.

2.07 MOUNTING

- A. Couple the engine and generator together through a flexible, non-backlash type, all metal coupling which overcomes all normal misalignment stresses and transmits full engine torque with ample safety factor. Also provide flexible connections for piping connections.

2.08 COOLING SYSTEM

- A. Provide a radiator manufactured of a non-corrosive material mounted on the engine. The radiator core shall be coated with a corrosion resistant coating. Corrosion resistant coating shall be a corrosion resistant baked phenolic coating or similar.
- B. Connect the radiator to the engine internal cooling system with flexible piping. Furnish appropriately sized coolant expansion tank for the cooling system.
- C. The engine shall be cooled through a radiator sized to continuously maintain safe operation at full load and at 105°F outside ambient air with 50% ethylene glycol coolant. A blower type fan and low noise fan drive and controls shall be furnished. The fan and all rotating members and drive belts shall be guarded and meet OSHA standards. Proof of 105°F ambient temperature capability shall be required.
- D. Coolant
 1. After the cooling system is flushed and cleaned, provide an initial fill of coolant

consisting of 50% ethylene glycol. An anti-corrosion treatment shall be added during the initial fill.

2. The coolant shall meet the requirements of the generator manufacturer including corrosion inhibitors provided in the coolant to protect the engine cooling system.
- E. The engine shall be equipped with coolant heaters. Heaters shall be in accordance with the following:
1. Unit mounted thermal circulation type coolant heater with coolant recirculation pump shall be furnished to maintain engine jacket coolant temperature as recommended by manufacturer in a 3 phase, ambient temperature of minus 20°F. The heater shall be 208 VAC, 60 hertz, 3-phase, thermostatically controlled.
 2. The heater shall be of sufficient capacity to keep the coolant at a suitable temperature for trouble-free starting.
 3. Each heater shall be provided with a suitable contactor to automatically disconnect the heater when the engine is started.

2.09 ENGINE STARTING AND CHARGING SYSTEM

- A. Engine starting batteries shall be sealed, lead-acid type, rated 12 volts, wired for 12 V starting batteries shall have adequate capacity for rolling the engine for five (5), ten (10) second cycles without starting, and then operating the control devices in the local generator controls as well as any connected transfer control devices for two (2) hours. The batteries shall be mounted on a suitable non-corrosive rack. Batteries shall have battery cables with lugs and shall be provided with lugs for connection to the battery charger.
- B. Battery charger shall be a U.L. 1236 listed, automatic, solid-state battery charger, 20 A (min.) current limited, $\pm 2\%$ voltage regulation, $\pm 10\%$ line voltage variation, automatic float equalizing system, DC voltmeter, and DC ammeter. Provide a Form C unpowered (dry) contact to indicate a low battery alarm condition.
- C. In addition, the engine shall be provided with an engine battery charging alternator that automatically changes the starting batteries during engine operation.

2.10 EXHAUST SILENCER

- A. Furnish and install an exhaust silencer. Silencers shall be of critical type and sized to produce a high degree of silencing. Reference the sound attenuation requirements specified herein.
- B. Connect the silencer to the engine exhaust manifold with a high corrosion and temperature resistant stainless steel flexible convoluted exhaust pipe. Use flange-type connections. Provide a taper-cut tail pipe complete with rain cap to exhaust the gases to the atmosphere.

- C. The silencer (if installed inside), exhaust piping, and expansion fittings, including collector box, shall be completely covered with a removable insulation blanket in order to protect operating personnel and to reduce noise. Insulation shall be of composite fiberglass and stainless steel construction capable of withstanding 1200°F continuously. The insulation blankets shall be tailored and custom fabricated to fit the contours of the manifolds. Average weight of the insulating blanket shall be 1.5 psf. Insulation shall conform to MIL-1-16411D, Type II and shall be custom fabricated to fit the contours of the components.
- D. The silencer system shall be designed, furnished, and installed to prevent moisture and condensation from corroding the silencer. All exterior components of the exhaust system shall be of 316 stainless steel.
- E. Silencer shall be mounted within the generator enclosure. Silencers shall be painted steel and insulated using a calcium silicate material covered by a brushed aluminum skin.

2.11 WIRING

- A. Furnish and install internal wiring in the engine-generator set. All internal wiring between the generator and engine-generator control panel, the on-board power source and all accessories shall be provided.

2.12 AUTOMATIC TRANSFER SWITCH

- A. Generator start shall be controlled from an existing dry contact output in the existing Pump Station automatic transfer switch.

2.13 BASE MOUNTED FUEL TANK

- A. The generator set shall be supplied with a double-walled, U.L.-142 listed base mounted fuel tank with a minimum capacity of 200 gallons. The base mounted fuel tank shall serve as a day tank for use with the diesel fuel supply system specified in Section 15484. The generator supplier shall coordinate with the supplier of the fuel oil system to ensure adequate tank openings are provided for fuel oil piping, tank instrumentation and other devices as required. The tank, painted in a color as selected by the Owner, shall be fabricated from steel with a rupture basin and leak detector system. Leak detection shall be as specified in Section 15484.
- C. The tank shall be supplied with all necessary fuel supply, return, vent, and fill fittings and a fuel level gauge.
- D. The underside of the tank shall not be in contact with the mounting surface (concrete pad).

2.14 WEATHERPROOF ENGINE - GENERATOR ENCLOSURE

- A. Furnish and install an outdoor, weather-protective housing. The housing shall be furnished complete with a full sub-base floor resulting in complete enclosure. The enclosure shall be factory-assembled to the engine-generator set base and radiator cowling. Lifting eyes shall be provided. Housing shall provide ample airflow for generator set operation. The housing shall be constructed of 12 gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel, reinforced to be vibration free in the operating mode. The housing shall have hinged

side-access doors and rear control panel access door. Each door shall have at least two latch-bearing points. All doors shall be lockable. All steel sheet metal shall be primed for corrosion protection and finish painted in a color as selected by the Owner. Roof shall be peaked to allow drainage of rain water. Unit shall have sufficient guards to prevent entrance by small animals. Batteries shall fit inside enclosure and alongside the engine (batteries under the generator are not acceptable). Unit shall have engine coolant and oil drains piped to outside the unit to facilitate maintenance. Each drain line shall have a valve located near the fluid source.

- B. A "Skin-tight" housing shall be provided. No walk-around access is required within the enclosure; however, adequate working clearance shall be provided as required by the NEC. Alternatively, access doors may be provided so that when opened, adequate working clearance is achieved in front of electrical equipment.
- C. Enclosure shall be sound attenuated to provide sound level as specified herein.
- D. The enclosure shall be furnished with a panelboard as indicated on the Drawings. This unit shall serve as the power distribution panel for all accessories specified herein and indicated on the Drawings (e.g. alternator mounted space heater, battery charger, leak detection system, etc.) that require "shore power". The enclosure manufacturer shall furnish and install conduit and wire necessary to provide the power from the unit to all accessories.
- E. All hardware (nuts, bolts, screws, washers, etc.) that is installed on the exterior of the generator enclosure shall be stainless steel. Galvanized steel hardware is not acceptable.
- F. Linear fluorescent or LED lighting shall be provided in sufficient quantity to maintain 20 foot-candles of illumination at floor level and shall be suitable for operation in cold weather. Compact fluorescent lighting fixtures are not acceptable. Interior lighting shall be controlled by 3-way light switches located at each door. Reference Section 16141.
- G. Convenience receptacles shall be furnished at each door within the enclosure. Receptacles shall be 125V, 20A, two-pole, three wire grounded type. Reference Section 16141.
- H. Conduit and wire shall be in accordance with Sections 16111 and 16123, respectively.
- I. All air intake louvers shall be furnished with rain guards or designed to eliminate water intrusion to the interior of the enclosure when the generator is operating at full load (maximum airflow) during rain events.

2.15 SOUND ATTENUATION

- A. Extreme care shall be exercised in providing equipment for and setting the engine-generator in place to guard against excessive noise transmission and vibrations. Fasten to the underside of the skids seismically-rated spring type isolators.
- B. The engine-generator enclosure shall be designed, furnished, and installed to reduce source noise to 76 dB(A) as measured at seven (7) meters from the enclosure.

2.17 FUEL STORAGE TANK

- A. The Contractor shall furnish and install a bulk fuel storage tank. Reference Section 15484, Fuel Storage Tanks.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The standby generator system shall be furnished and installed as indicated on the Drawings and as recommended by the equipment manufacturer.
- B. The initial filling of the fuel storage tank shall be provided by the Contractor. Fuel tank shall be filled to its full capacity. At the conclusion of all field testing, the Contractor shall fill the fuel storage tank back to its full capacity. Fuel shall be ultra-low sulfur diesel Grade No. 2D S15 in accordance with ASTM D-975. Fuel shall be new and free from contaminants and water.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified generator manufacturer's factory-trained technical representative who shall adequately supervise the installation and of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.
- B. The manufacturer's technical representative shall perform all startup and field testing of the generator assembly as specified herein.
- C. The Contractor shall provide training for the Owner's personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner's personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of four (4) hours each. Training shall not take place until after the generator has been installed and tested. Training shall be conducted at times coordinated with the Owner.
- D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One (1) trip of two (2) working days during installation of the engine-generator set.
 - 2. One (1) trip of one (1) working day to perform startup of the engine-generator set.
 - 3. One (1) trip of two (2) working days to perform the field testing of the engine-generator set.
 - 4. One (1) trip of one (1) working day to perform training as specified herein.
- E. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

3.03 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

a. None required.

2. Certified Shop Tests

a. Fully test the engine-generator set with all accessories in the manufacturer's plant before shipment. Tests shall be conducted through the use of balanced, three-phase, dry-type, resistive load banks.

b. Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure.

c. The manufacturer shall conduct a shop test run of at least six (6) consecutive hours for the set under the following conditions of load, in the following order:

3 hours - full load

1 hour - 3/4 load

1 hour - 1/2 load

1 hour - 1/4 load

d. Fuel, lubricants, and other fluids as required for the shop tests shall be furnished by the manufacturer.

2. Field Tests

a. Field tests shall be performed by the generator manufacturer's technical representative. The Contractor shall obtain from the manufacturer and submit a detailed field test plan and procedures documenting the intended field test program.

b. In the presence of the Engineer and Owner, the representative shall inspect, adjust, and test the entire system after installation and leave in good working order. Field tests specific to each generator shall be conducted after the entire engine-generator system is installed including, but not limited to, the following: diesel fuel tanks including leak detection, exhaust silencer, radiators, enclosures, batteries, and all other equipment included in the complete system.

c. Field test the generator enclosure to ensure the enclosure performs as specified herein. The generator enclosure field tests shall include water tests to confirm the enclosure does not leak and that the air intake louvers eliminate water intrusion to the interior of the generator enclosure when the generator is operating at its full load capacity (maximum airflow). A garden hose shall be used to simulate falling rain for this test. Water supply and garden hose will be provided by the Owner for this test.

- d. Field test, as far as practicable, all control, shutdown, and alarm circuits. Document the successful completion of these tests as witnessed by the Owner and the Engineer.
- e. Generator load tests shall be conducted through the use of balanced, three-phase, dry-type, reactive (0.8 power factor) load banks. Conduct a continuous run test using the load bank without shutdown for the engine-generator set under the following load conditions (in this specific order) and in the presence of the Owner and Engineer:
- 5 hours, full load
 - 1 hour, 3/4 load
 - 1 hour, 1/2 load
 - 1 hour, 1/4 load

Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure every 15 minutes during the continuous run test. If any failures, malfunctions, and/or shutdowns occur during this test, the problems shall be fixed and the test shall be restarted. The test shall not be considered complete until the generator has operated for eight (8) consecutive hours without any shutdowns under the conditions listed above.

- f. After successful completion of the load bank tests, the generator system shall then be operated for a minimum of four (4) hours with plant loads during a time period when the plant is operating at average demand. The same data shall be recorded at 15 minute intervals for this load test as for the load bank test.
- g. The generator and automatic transfer controls shall be tested as an overall system in the presence of the Engineer and Owner. Utility service outages shall be **simulated** to allow automatic controls to perform the transfers, transfers shall not be manually initiated. As a minimum, the generator and switchgear automatic transfer tests shall be performed as follows:
- Three (3) closed transition transfers from the utility service to the generator and then back to the utility service at 90% of full load.
 - Three (3) closed transition transfers from the utility service to the generator and then back to the utility service at 50% of full load.
 - Three (3) closed transition transfers from the utility service to the generator and then back to the utility service under the then current plant operating load.

It is the intent that these tests take place utilizing plant loads. If the system cannot be fully loaded as required by the plant loads, the manufacturer shall connect a reactive load bank to a spare circuit breaker in the switchgear as needed to test the system under the loads described above. If any failures, malfunctions, and/or shutdowns occur during any of the transfer tests listed above, the problems shall be fixed and the test shall be restarted. Each test shall not be considered complete until the generator/switchgear system has

performed the required number of transfers consecutively without any failures or malfunctions. During the transfer testing above, the loads shall remain on the utility or generator source for at least five (5) minutes in between transfers.

h. The Contractor shall collect a sample of engine oil from each engine for analysis after the start-up and testing has been completed. The sampling method shall be of the atomic absorption spectrophotometry method and be accurate to within a fraction of one part per million for the following elements:

- Iron
- Chromium
- Copper
- Aluminum
- Silicon
- Lead

The sample shall also be tested for the presence of water, fuel dilution, and coolant.

The oil samples shall be analyzed at an independent laboratory that is not a part of the engine supplier's facility. Immediate notification of critical results shall be provided to the Owner when the analysis shows any critical reading.

i. All fuel, lubricants, and other fluids required to complete all field tests shall be paid for by the Contractor.

3.04 PAINTING

A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

- END OF SECTION -

SECTION 16902

ELECTRIC CONTROLS AND RELAYS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.
- B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.
- C. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.

1.02 CODES AND STANDARDS

- A. Products specified herein shall be in conformance with or listed to the following standards as applicable:
 - 1. NEMA 250 – Enclosures for Electrical Equipment
 - 2. UL 508A – Standard for Industrial Control Panels
 - 3. UL-1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 4. ANSI/ISA 12.12.01-2013 – Nonincendive Electrical Equipment for use in Class I and II, Division II Hazardous (Classified) locations.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:
 - 1. One (1) contact block of each type furnished on the project
 - 2. One (1) indicating light lens of each color furnished on the project
 - 3. One (1) LED lamp of each color furnished on the project
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

PART 2 -- PRODUCTS

2.01 CONTROL COMPONENTS

- A. Manufacturers

1. Control components shall be manufactured by Eaton, The Square D Company, General Electric, Allen-Bradley, Siemens Energy and Automation, or Engineer approved equal.

B. Pilot Devices

1. General

- a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (i.e. HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc).
- b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.
- c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.
- d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- e. In Class 1 Division 2 hazardous locations, pilot devices shall be the hermetically-sealed type, constructed in accordance with ANSI/ISA 12.12.01.

2. Pushbuttons

- a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.
- b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.
- c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

3. Selector Switches

- a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.

- b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.
 - c. Where indicated in the Drawings or Specifications, provide spring return positions.
 - d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.
4. Indicating Lights
- a. Indicating lights shall LED type, with the proper voltage rating to suit the application, and push-to-test feature.
 - b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:
 - i. Red - "Run", "On", "Open"
 - ii. Green - "Off", "Closed"
 - iii. Amber - "Alarm", "Fail"
 - iv. White - "Control Power On"
5. Emergency Stop and Tagline Switches
- a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.
 - b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.
 - c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

C. Relays and Timers

1. General

- a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.
 - b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.
 - c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
2. Control and Pilot Relays
- a. Miniature or "ice-cube" type relays are not acceptable.
 - b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
 - c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.
3. Time Delay Relays
- a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.
 - b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
 - c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.
 - d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.
4. Elapsed Time Meters
- a. Elapsed time meters shall be non-resettable type with no less than a 4 digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.

D. Control Terminal Blocks

1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 - #8 AWG.

2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (i.e. 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.
3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

2.02 LOCAL CONTROL STATIONS

- A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.
- B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.
- C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Die Cast Zinc
Indoor Dry Non-process Area	NEMA 12, Die Cast Zinc
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or Thermoplastic Polyester
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 9, Die Cast Aluminum

- E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure.
- F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class 1 Division 1 and Class 2 Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class 1 Division 2 hazardous locations shall be in accordance with ANSI/ISA 12.12.01-2013.

- G. Provide a nameplate on each local control station in accordance with Section 16195, Electrical Identification. The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words "LOCAL CONTROL STATION".

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.
- B. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.
- C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.
- D. Local control station covers shall be bonded to the local control station enclosure through the use of an insulated green bonding conductor.
- E. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.
- F. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors.

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SECTION 16903

CABINETS AND ENCLOSURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.
- B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 16130 – Electrical Boxes
- B. Section 16902 – Electrical Controls and Relays
- C. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.
- B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.
- C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. Provide touch up paint matching the cabinet color.

PART 2 -- PRODUCTS

2.01 CABINETS AND PANELS

- A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.
- B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.
- C. Cabinets shall be NEMA 4X stainless steel where located outside or as indicated on the Drawings. Cabinets not otherwise designated shall be NEMA 12.
- D. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Door latches for NEMA 4X cabinets shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure.
- E. Panels and cabinets located outside fence-secured areas shall be fitted with padlockable latch kits.
- F. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.
- G. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC or DCU) shall be provided with a folding laptop programmer shelf on the inside of the door.
- H. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Rittal. The Contractor may optionally provide cabinets that are custom-fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

2.02 TERMINAL BLOCKS

- A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Wieland, Square D, or equal.
- B. Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30 amps.

- C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

2.03 SIGNAL CONVERTERS

- A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.
- B. General Requirements – Converters shall be of the miniature type, utilizing all solid state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided. Power supply shall be 120V, 60 hertz where required by the converter. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.
- C. Current to Current Isolators – Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

2.06 CONTROL PANEL RELAYS

- A. Interposing Relays – Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be miniature type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall be Type KU as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.
- B. Timing Relays – Timing Relays (TR) shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, Cutler-Hammer/Westinghouse Electric Corporation equivalent, Allen-Bradley equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.
- C. Relays switching power to line voltage devices such as valve motors, solenoids, and motor driven equipment shall be in accordance with Section 16902 Electronic Controls and Relays.

2.07 PILOT DEVICES

- A. As described in Section 16902 Electronic Controls and Relays.

2.08 SURGE PROTECTION

*Raw Water Pump Station
Generator Replacement*

- A. Provide surge/lightning protection as indicated. Surge protective Devices shall be UL 1449 and constructed as a replaceable module. Modules shall mount on a terminal block secured to a standard DIN rail. It shall be possible to replace the surge module without rewiring. Units shall provide line to line and line to ground protection. Protection level shall be < 1.5 kV, unless otherwise indicated.
- B. Modules shall include a visible status indicator displaying the health of the unit.
- C. Units shall be Phoenix Flashtrab/Plugtab, or an approved equal.
- D. Units shall be selected based on application as listed below:
 - 1. Line Voltage – Nominal voltage 240v, 3 conductor protection, impulse protection to 50 kA.
 - 2. Analog Input – Nominal voltage 24 Vdc, impulse protection to 25 kA.
 - 3. Discrete input – Nominal voltage 24 Vdc, impulse protection to 25 kA.
- E. Communications surge protection shall be specifically designed for the data traffic be handled with surge protection rating adequate for use with the equipment.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:
 - 1. Louvered openings near the bottom and top (NEMA 12 cabinets only).
 - 2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75°F) to circulate air within the enclosure, maintaining a uniform internal temperature.
 - 3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.
 - 4. All openings in cabinets and panels shall be fitted with dust filters.
- C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.

- D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.
- E. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- F. Wiring shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 16 of the specifications. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
- G. Separate terminal strips shall be provided for each type of power and signal used within each cabinet.
- H. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring.
- I. A copper 120 VAC ground bus shall be installed in each cabinet, and shall be connected to the building power ground. A separate, isolated copper ground bus shall be installed in each cabinet for the logic (24 VDC) ground. Both ground buses shall be clearly labeled as to voltage and function.
- J. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire numbering system and identification tags shall be as specified in Section 16123 - Building Wire and Cable. Where applicable, the wire number shall be the ID number listed in the input/output schedules.
- K. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK

120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED

120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED

DC Power (-) - BLACK

DC Control - BLUE

Analog Signal – BLACK/WHITE or BLACK/RED

- L. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.
- M. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and fluorescent service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.
- N. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power". Letters in the word "WARNING" shall be 0.75 inch high, white.
- O. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.02 PAINTING

- A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 9 for additional requirements.
- B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.
- C. Panels fabricated from stainless steel shall not be painted.

3.03 INSTALLATION

- A. Refer to Section 16000 for additional requirements.

- END OF SECTION -