

CONTRACT DOCUMENTS AND SPECIFICATIONS

FOR

Water Plant No. 2 Storm Damage Repairs

IN

CYPRESS FOREST PUBLIC UTILITY DISTRICT

HARRIS COUNTY, TEXAS

February 2020



2/17/2020

Prepared by:

A handwritten signature in black ink that reads "Nabil A. Joubbran".



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Houston, Texas 77024
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www.pepe-engineering.com

TBPE Firm Registration No. F-2736

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Date: February 21, 2020

INVITATION TO BIDDERS

Sealed Bids, in duplicate, addressed to Cypress Forest Public Utility District, Attention Gregory DiCioccio, President, Board of Directors, will be received at the office of Pepe Engineering, 10497 Town & Country Way, Suite 700, Houston, Texas 77024, until 11:00 AM Local Time, Monday March 16, 2020, and then publicly opened and read for “Water Plant No. 2 Storm Damage Repairs in Cypress Forest Public Utility District in Harris County, Texas.” Bids received after the closing time will be returned unopened.

Each Bid must be accompanied by a bid bond or a certified or cashier’s check, acceptable to the Owner, in an amount not less than 10 percent of the total amount bid, as a guarantee that the successful bidder will enter into the Contract and execute the Bonds on the forms provided and provide the required insurance certificates within 7 days after the date Contract Documents are received by the Contractor.

Copies of the bid documents are available to download from the BIDS tab at the following location: www.pepe-engineering.com. There is NO charge to view / download documents.

Bidding documents may be examined at the above location or may be obtained by prospective bidders or suppliers upon payment of One Hundred and Fifty Dollars (\$150.00 non-refundable) for each set of documents at Pepe Engineering (by prior request). Checks should be made payable to Pepe Engineering. No cash will be accepted.

Inquiries from prospective bidders will be considered in writing only, via email to njoubran@pepe-engineering.com, and must be received no later than COB on Thursday March 6, 2020. If necessary, an addendum will be issued by COB on Monday March 9, 2020 and will be posted on the BIDS tab at the following location: www.pepe-engineering.com.

The Owner reserves the right to reject any or all Bids and to waive all defects and irregularities in bidding or bidding process except time of submitting a Bid. The Successful Bidder, if any, will be the responsible Bidder which in the Board’s judgment will be most advantageous to the District and result in the best and most economical completion of the Project.

PEPE ENGINEERING

CYPRESS FOREST PUD

INSTRUCTIONS TO BIDDERS

1. PREPARATION OF BIDS. Unless otherwise directed in the Invitation to bidders, each Bid shall be submitted, in duplicate, on the bid forms provided or on photocopies of the forms, in conformity with the requirements of the Invitation to bidders, these instructions, and the instructions printed on the bid form.

All blanks on the bid form shall be completed, typed, or written in ink, and no change shall be made on the bid form or any other of the Contract Documents. All amounts shall be written in figures, with amounts extended and totaled. Minimum unit prices have been established for certain items shown on the bid. See Paragraph 7 of these instructions. If the bidder chooses not to bid on optional items (if any), "No Bid" shall be entered in the bid space. Any Bid may be rejected if it contains any omission, erasure, alteration, addition, irregularity of any kind, or items not called for; if it does not submit prices for each of the items in the bid form; if any of the prices are obviously unbalanced; or if it shall, in any manner, fail to conform to the conditions of the Invitation to bidders and these instructions.

The bidder shall sign its Bid in the signature space. If the Bid is made by a partnership or corporation, the name and address of the partnership or corporation shall be shown, together with the names and addresses of the partners or officers. If the Bid is made by an individual, it must be executed by that person; if made by a partnership, it must be executed by one of the partners (and if by a limited partnership, then executed by the general partner); or if made by a corporation, it must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or assistant secretary of the corporation. The corporate address and state of incorporation must be shown below the signature.

When applicable, evidence of authority to conduct business as an out-of-state corporation in the State of Texas shall be provided in accordance with the paragraph entitled QUALIFICATION OF BIDDERS. State Contractor license number, if any, must also be shown.

The Bid and the Bid Security must be enclosed in a sealed envelope, plainly identified on the outside with the contents (i.e. Bid or Bid Security), the bidder's name, and the job name and number, and addressed to the Owner as prescribed in the Invitation to Bidders.

2. CONTRACT DOCUMENTS. The Contract Documents are complementary and must be read together as a whole; what is called for by one is as binding as if called for by all.

Bidders desiring further information or further interpretation of any part of the Contract Documents are hereby obligated to submit a written request to njoubran@pepe-engineering.com website (contact us link) for such information to Engineer not less than **3 calendar days** before the Bid opening. Answers to these requests will be given, in writing, to all bidders as addenda to the Contract, and each addendum will be made a part of the Contract. No explanation or interpretation of the Contract, other than written addenda, shall be binding.

Should a bidder find discrepancies in or omissions from the Contract Documents or should the bidder be in doubt as to any meaning, the bidder is hereby obligated to notify Engineer, so a written

addendum may be sent to all bidders. It is the responsibility of each bidder to determine if it has received all addenda, complete files of which will be maintained at the Engineer's office and the office designated to receive the Bids.

Each bidder shall inform itself fully of the construction and labor conditions under which the Work will be performed and shall be presumed to have inspected the Site and to have read and to be thoroughly familiar with the Contract Documents. Failure to do so will not relieve the successful bidder of its obligation to furnish all materials and labor necessary to carry out the provision of the Contract and to complete the Work for the consideration of its Bid.

3. **PRE-BID CONFERENCE.** The Cypress Forest Public Utility District has waived the requirement for a Mandatory Pre-Bid Conference. As an alternative, any inquiries from prospective bidders will be considered **in writing only**, via email to njoubran@pepe-engineering.com, and must be received no later than COB on Thursday March 6, 2020. If necessary, an addendum will be issued by COB on Monday March 9, 2020 and will be posted on the BIDS tab at the following location: www.pepe-engineering.com.

4. **BID SECURITY.** Each Bid shall be accompanied by a bid bond or a certified or cashier's check, acceptable to the Owner, in an amount not less than 10 percent of the total amount bid (the "Bid Security"), as a guarantee that the successful bidder will enter into the Contract and execute the Bonds on the forms provided and provide the required insurance certificates within 7 days after the date Contract Documents are received by the Contractor. Bid Securities will be returned to all but the three most qualified, responsible bidders within 5 days after opening of Bids, and the latter's Bid Securities will be returned after complete execution of the Contract. The surety company providing a bid bond must conform to the same requirements for surety companies providing the performance bonds, maintenance bonds and/or payment bonds described below.

5. **BONDS.** The successful bidder must furnish a Performance and Maintenance Bond and a Payment Bond, each in the sum of 100 percent of the Contract Price, from a surety company holding a permit from the State of Texas to act as surety. Unless otherwise specified, the cost of proving such Bonds shall be included in the bidders total bid amount. The surety company must have a minimum Best Key Rating of "B+" or better. The surety company, the agency and agent issuing the Bonds must be authorized to issue Bonds in Texas in an amount equal to the total Contract Price and such authorization must be recorded in the files of the Texas Department of Insurance. The Bonds must be executed by a duly appointed representative of the surety company licensed by the State of Texas as a General Lines Agent and such licensing must be recorded in the files of the Texas Department of Insurance. If the surety company does not have such a rating due to the length of time it has existed, the surety company must be eligible to participate in the surety bond guarantee program of the Small Business Administration and must be an approved surety listed in the current U.S. Department of Treasury Circular 570, and must meet all of the rules and regulations of the Treasury Department with respect to performance and payment bonds for federal jobs, including specifically the rules related to underwriting limitation. For contracts over \$100,000, the surety must also hold a certificate of authority from the United States Secretary of Treasury to qualify as a surety on obligations permitted or required under federal law, or have obtained reinsurance for any liability in excess of \$1,000,000 from a reinsurer that is authorized and admitted as a reinsurer in the State of Texas and is the holder of a certificate of authority from the United States Secretary of Treasury to qualify as a surety or reinsurer on obligations permitted or required under federal law. If bidder's proposed surety company, agency or agents do not meet the aforementioned requirements, then

Owner may refrain from considering the bidder for Contract award and Owner may require bidder to forfeit the Bid Security.

6. DELIVERY OF BIDS. It is each bidder's responsibility to deliver its Bid and Bid Security to the location named in the Invitation to Bidders before the closing time. The fact that a Bid and Bid Security were dispatched will not be considered. The Bid and Bid Security must actually be delivered to be considered.

7. "OR EQUAL" SUBMISSIONS. Where materials or equipment are specified by a trade or brand name, it is not the intention of the Owner to discriminate against an equal product of another manufacturer, but to set a definite standard of quality or performance. In preparing his/her proposal, each bidder is expected to include in his/her base Bid the cost of the item so specified. However, in certain Technical Specification sections, manufacturers are listed followed by "or equal." In certain other Technical Specification sections, manufacturers are listed with "or equal" not included. In those items where "or equal" is not included, it is hereby added and understood to be included, even though not specifically stated in each and every Technical Specification. If a Contractor chooses to submit a suggested "or equal" product in lieu of a product by one of the named manufacturers, Owner will evaluate the item to determine if it is an equal. The Contractor is responsible for providing all data required to evaluate an item submitted as a suggested "or equal." Owner's decision on whether an unnamed manufacturer is an "equal" is to be final. No claims for additional cost, time delay, etc. will be accepted if an unnamed manufacturer is submitted by Contractor as a suggested "equal" and Owner decides the item is not "equal."

Contractor must submit list of items to be submitted as a suggested "or equal" at time of bid submission. No additional suggested "or equal" items will be considered after bid opening.

8. MINIMUM AND EXTRA UNIT PRICE ITEMS. If the approximate quantity and a minimum unit price have been established for items as shown in the Bid, the bidder may not bid a unit price less than the minimum value; however, it may bid an amount greater than the minimum unit price. If no entry is made in the spaces provided, the minimum unit prices shown shall apply. These Extra Unit Price Items are included to facilitate payment for changes and alterations that may be required to complete the Work. The Work, as provided by the Contract Documents, is described in bid items other than Extra Unit Price Items. When additional Work covered by Extra Unit Price Items is performed, payment will be based on the quantity actually constructed and the unit prices entered in the Bid.

9. TIME FOR COMPLETION. Contractor will not be allowed time extensions that are due to (i) inclement weather (not including Force Majeure); (ii) non-availability of equipment or material, when the principal units of Work and tasks on the critical path are not in progress or are not delayed by the event of delay, interference, disruption, or hindrance; (iii) when at least seven (7) hours of available working time remain out of the working day; (iv) while materials are drying and it is possible for the Contractor to enclose the area and use drying devices; (v) when an event of delay, interference, disruption, or hindrance occurs on a day other than a working day or other day when the

Contractor had not originally planned to work; (vi) when an event of delay, interference, disruption, or hindrance occurs after the expiration of the time for completion; (vii) to the extent the Contractor could have anticipated or alleviated the impact of the event of delay, interference, disruption, or hindrance through reasonable efforts; (viii) when events of concurrent delay overlap the claimed delay; and/or (ix) when an extension of time is precluded by any other provision of the Contract Documents.

10. QUALIFICATION OF BIDDERS. The apparent most qualified, responsible bidder shall submit to Owner, within **5 calendar days** of notification, either i) a fully completed Contractor's Statement of Qualification or ii) a written statement that the most recently submitted Contractor's Statement of Qualification is accurate, which statement shall be considered in the award of the Contract. Failure to accurately complete the Contractor's Statement of Qualification or to submit the Statement will, at Owner's option, disqualify the bidder from consideration in the award of the Contract. The form of the Contractor's Statement of Qualification is available from Engineer. No other form of Statement of Qualification will be acceptable. Evidence of out-of-state corporation to conduct business in the state in which the Work is to be performed, along with state contractor license number, must also be provided.

11. MODIFICATION AND WITHDRAWAL OF BIDS. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids. If, within twenty-four hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid and the Bid Security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided under the Contract Documents.

12. HOUSE BILL 1295. Provision of Texas Ethics Commission Form 1295 ("TEC Form 1295") by Bidders: Effective January 1, 2016, pursuant to Texas Government Code § 2252.908 (the "Interested Party Disclosure Act" or the "Act"), the District may not award the contract to a bidder unless the bidder has provided to the District a completed, signed and notarized TEC Form 1295 which has been assigned a certificate number by the Texas Ethics Commission (the "TEC"). Pursuant to the rules prescribed by the TEC, the TEC Form 1295 must be completed online through the TEC's website, assigned a certificate number, printed, signed and notarized, and provided to the District. The TEC Form 1295 may accompany the bid or may be submitted separately, but must be provided to the District prior to the award of the contract. For purposes of completing the TEC Form 1295, the entity's name is [District's name]; the contract ID number is [Engineering Job No.]; and the description of goods and services is [name of project/contract]. Neither the District nor its consultants have the ability to verify the information included in a TEC Form 1295, and neither have an obligation nor undertake responsibility for advising any bidder with respect to the proper completion of the TEC Form 1295.

13. AWARD OF CONTRACT. Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, non-responsive, unbalanced or conditional Bids and to reject the Bid of any bidder if Owner believes that it would not be in the best interest of the Project to make award to that bidder, whether because the Bid is not responsive or the bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or

criteria established by Owner. Owner also reserves the right to waive all informalities and defects in bidding, except time of submitting a Bid. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

In evaluating Bids, Owner will consider, among other things, the qualifications of bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award. Alternate bid items will not be considered unless requested in the Bid Form.

Owner may consider the qualifications and experience of subcontractors, suppliers, and other persons and organizations proposed for the Work. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work.

Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of bidders, proposed subcontractors, suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents, to Owner's satisfaction.

BY SUBMITTING A BID, EACH BIDDER AGREES TO FULLY AND FOREVER WAIVE AND RELEASE ANY CLAIM (KNOWN OR UNKNOWN) IT HAS OR MAY HAVE AGAINST THE OWNER, ENGINEER, DEVELOPER AND THEIR RESPECTIVE ATTORNEYS, EMPLOYEES, CONSULTANTS, REPRESENTATIVES, AND AGENTS ARISING OUT OF OR IN CONNECTION WITH THE: (I) ADMINISTRATION, EVALUATION, OR RECOMMENDATION (OR LACK THEREOF) OF ANY BID; (II) WAIVER OF ANY REQUIREMENTS UNDER THE BID DOCUMENTS OR THE CONTRACT DOCUMENTS; AND (III) ACCEPTANCE OR REJECTION OF ANY BIDS AND AWARD OF THE CONTRACT.

Owner reserves the right to award the Bid, at Owner's discretion, based on the amount of the Total Base Bid (without including "Extra Unit Price Items" or "alternate" bid items) or on the amount of the Total Amount Bid (including "Extra Unit Price Items" items or "alternate" bid items), or based on any other combination, means or method determined appropriate by Owner.

If the contract is to be awarded, it will be awarded to the responsible bidder whose evaluation by Owner indicates that the award will be most advantageous to the Owner and result in the best and most economical completion of the Work.

If the contract is to be awarded, Owner will give the successful bidder a notice of award within ninety days after the day of the Bid opening.

Within 10 calendar days of receipt from the Owner of the Notice of Award, the successful bidder must submit to the Engineer the original Bonds and all information or other items necessary to complete the Contract Documents, including the Schedule of Completion and Contractor's safety program. The successful bidder must return the fully executed Contract Documents to Engineer within 7 calendar days of receipt, or Owner may at its sole discretion disqualify the bid and accept another bid and the bidder shall, at Owner's option, forfeit its bid security.

14. TAXES, LICENSES AND FEES. Certain taxes, licenses, fees and other similar items are part of the cost of the Work and it shall be Contractor's responsibility to familiarize itself with these

costs and to observe and comply with the Laws and Regulations relating to the same. The prices, sums, rates and other charges set forth in the Contractor's Bid shall cover and include all such costs. Owner is exempt from Texas sales and use taxes pursuant to Texas Tax Code § 151.309 as a political subdivision of the State of Texas. Owner shall provide Contractor, if requested by Contractor in writing, with a completed Texas Sales and Use Tax Exemption Certification as evidence of the applicability of such exemption and Contractor shall not collect Texas sales and use taxes from Owner with respect to this contract. Contractor and all subcontractors to Contractor shall issue a Texas Sales and Used Tax Exemption Certification with respect to, and shall not pay Texas sales and use taxes on, all purchases of the following items that are exempt from Texas sales and use taxes pursuant to Texas Tax Code § 151.311: (i) tangible personal property that will be incorporated into Owner's realty; (ii) tangible personal property that is necessary and essential for the performance of this contract and is consumed entirely on the job site; and (iii) taxable services for use in the performance of this Contract that are performed at the job site and are either integral to the performance of this Contract or expressly required to be provided by this Contract. In addition, Contractor and all subcontractors to Contractor (i) shall not include any provision for Texas sales and use taxes with respect to such exempt items in any Bid or the Contract Price, and (ii) shall pass on to the Owner cost savings due to the exempt status of such exempt items. Contractor's contracts with all subcontractors to Contractor shall include the foregoing provision regarding the exemption from Texas Sales and use taxes. Contractor must pay taxes on items that are not exempt.

15. NUMBER OF SIGNED SETS OF DOCUMENTS. The Contract Documents will be prepared in at least five original sets for signature, one for delivery to the successful bidder. Owner will furnish the successful bidder two sets of Plans and Technical Specifications free of charge, and additional sets may be obtained from Engineer at Engineer's reproduction rates. The successful bidder shall provide three signed originals of each of the Bonds to be bound with the Contract Documents.

16. WORKER'S COMPENSATION INSURANCE. See section entitled "INSURANCE" in Special Conditions Part A of the Contract.

17. SOILS REPORT. If a soils investigation has been made for this project, the soils report and log of borings is available for bidder's information only. The report is not a warranty of subsurface conditions, nor is it a part of the Contract Documents. Bidders are expected to examine the Site and such reports and then decide for themselves the character of the materials to be encountered.

Owner and Engineer disclaim any responsibility for the accuracy, true location and extent of the surface and subsurface investigations that have been prepared by others. Owner and Engineer further disclaim responsibility for interpretation of that data by bidder, *i.e.* projecting soil-bearing values, rock profiles, soil stability and the presence, level and extent of underground water or underground facilities.

18. LABOR CLASSIFICATION AND MINIMUM WAGE SCALE.

(A) General: Chapter 2258 of the Texas Government Code provides that any political subdivision of the State of Texas shall ascertain the general prevailing wage rate received by the classes of workers employed on projects similar to this project and shall specify in the call for Bids and in the Contract the minimum wage rates which shall be paid for each type of worker. This statute further provides that the Contractor or subcontractors shall pay, as penalty, to Owner Sixty Dollars (\$60.00) for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the Contract. Owner is authorized to withhold from the Contractor the amount of this penalty from any payment due under the Contract.

The statute likewise requires that the Contractor and subcontractors keep an accurate record of the names and occupations of all persons employed by them on the construction of the Project and to show the accrual per diem wages paid to each worker. These records are open to the inspection of Owner.

(B) The minimum wage rates that apply to this Contract are specified in the Special Conditions Part A of the Contract. Contractor and subcontractors shall review and ascertain such wage rates and pay at least such minimum rates.

BID PROPOSAL

FOR

**Water Plant No. 2
Storm Damage Repairs**

CYPRESS FOREST PUBLIC UTILITY DISTRICT

HARRIS COUNTY, TEXAS

CYPRESS FOREST PUD – WATER PLANT N0. 2 STORM DAMAGE REPAIRS

EST. QUAN.	UNIT	DESCRIPTION OF ITEM AND UNIT PRICES (IN WORDS & NUMERALS)		UNIT PRICES	TOTAL AMOUNT
1	LS	Electrical System Installation Provide demolition as indicated on plans. Provide and install all equipment, MCC, controls, SCADA, operators SCADA, service equipment, power feeders, relocated ATS, autosensory control section, and perform rehab work for pump room, control room & chlorine room, install GST & HT devices, lighting and receptacles as shown on plans and described in specifications and as shown on plans for a complete operating system for a lump sum of:			
				_____ Dollars & _____ Cents	\$ _____
1	LS	SCADA Controller Programming & Commissioning Include an "Allowance" for plant SCADA programming and commissioning per Specifications 16012 and 16904 for a lump sum of: Seventy-Six Thousand Five Hundred _____ Dollars & Zero _____ Cents		\$ 76,500.00	\$ 76,500.00

CYPRESS FOREST PUD – WATER PLANT N0. 2 STORM DAMAGE REPAIRS

EST. QUAN.	UNIT	DESCRIPTION OF ITEM AND UNIT PRICES (IN WORDS & NUMERALS)		UNIT PRICES	TOTAL AMOUNT
1	LS	Electric Service Include an “Allowance” for electric service by the local Electric Service Provider. Exact amount will be reimbursed to Contractor upon submittal of invoice from Electric Service Provider for a lump sum of:			
		Twenty Thousand	Dollars &		
		Zero	Cents	\$ 20,000.00	\$ 20,000.00
1	LS	Natural Gas Generator System Provide and install a natural gas generator and all required appurtenances as shown on plans and as described in specifications for a complete operating system for a lump sum of:			
			Dollars &		
			Cents	\$	\$
1	LS	Natural Gas Service Include an “Allowance” for natural gas service by the local Gas Service Provider. Exact amount will be reimbursed to Contractor upon submittal of invoice from Service Provider for a lump sum of:			
		Twenty Five Thousand	Dollars &		
		Zero	Cents	\$ 25,000.00	\$ 25,000.00

CYPRESS FOREST PUD – WATER PLANT N0. 2 STORM DAMAGE REPAIRS

EST. QUAN.	UNIT	DESCRIPTION OF ITEM AND UNIT PRICES (IN WORDS & NUMERALS)		UNIT PRICES	TOTAL AMOUNT
1	LS	Elevated Steel Platform			
		Provide and install elevated steel platform and all related work as shown on plans and as described in specifications for a complete operating system for a lump sum of:			
			Dollars &		
			Cents	\$	\$
1	LS	Platform Canopy			
		Provide and install platform canopy and all related work as shown on plans and as described in specifications for a complete operating system for a lump sum of:			
			Dollars &		
			Cents	\$	\$

The undersigned hereby agrees to complete all of the work indicated in the Engineer's Technical Specifications found herein within 365 consecutive calendar days.

Receipt is hereby acknowledged of the following addenda to the Contract Documents:

Addendum No. 1 Dated _____ Received

Addendum No. 2 Dated _____ Received

Addendum No. 3 Dated _____ Received

Addendum No. 4 Dated _____ Received

Enclosed herewith is a Bidder's Bond, Certified Check or Cashier's Check made payable to:

10%GAB _____ Dollars (WORDS)

said amount being 5% of the largest possible total of the submitted bid.

In submitting this bid, it is understood that the Owner reserves the right to reject any and/or all bids or to accept the bid deemed most advantageous to the Owner.

The undersigned certifies that the bid prices contained in this proposal have been checked and are submitted as correct and final.

Respectfully Submitted,

Bidder: _____

By: _____

Address: _____

ATTEST:

(Secretary of Corporation)

Telephone: _____

CONTRACTOR'S AFFIDAVIT

OWNER: CYPRESS FOREST PUBLIC UTILITY DISTRICT

PROJECT: Water Plant No. 2 Storm Damage Repairs

PEPE PROJECT NO. 3320

CONTRACT DATE: _____

CONTRACTOR: _____

I certify that all just and lawful bills against the below named Contractor, for labor, material and expendable equipment employed in the performance of said contract have been paid in full prior to acceptance of final payment of the owner to complete the contract requirements. This is to certify that I am relieving **CYPRESS FOREST PUBLIC UTILITY DISTRICT** of any liability and claims of all debts occurring in connection with this project.

FIRM: _____

BY: _____

TITLE: _____

DATE: _____

Signed and sworn to before me a Notary Public in and for _____ County,

This ____ day of _____, 2020.

Notary Public Signature

Expiration Date

NOTE: This form shall be filled out, notarized and submitted with the Contractor's final Estimate for Payment.

AGREEMENT

STATE OF TEXAS }

COUNTY OF HARRIS }

THIS AGREEMENT ("Agreement") is made and entered into this _____ day of _____, 20__, by and between CYPRESS FOREST P.U.D. c/o Allen Boone Humphries Robinson LLP, 3200 Southwest Freeway, Suite 2600, Houston, Texas 77027, of Fort Bend County, Texas, and _____, _____, of the City of _____, County of _____, and State of _____, hereinafter termed "Contractor."

All capitalized terms used herein shall be given the meanings set forth in the General Conditions. Pepe Engineering shall be referred to herein as the "Engineer."

For and in consideration of the mutual covenants hereinafter set forth, and under the conditions expressed in the Bonds bearing even date herewith, the Contractor and Owner hereby agree as follows:

Contractor shall commence and complete the Work generally described as follows:

Water Plant No. 2 Storm Damage Repairs
in Cypress Forest Public Utility District
in Harris County, Texas
for CYPRESS FOREST P.U.D.,
Harris County, Texas,
according to those particular Plans and Technical Specifications
prepared by Engineer
in the initial Contract Price of \$_____

and all Extra Work in connection therewith, under the terms as stated in the General and Special Conditions of the Agreement, and, at Contractor's own proper cost and expense, to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said Work, in accordance with the conditions and prices stated in the Bid attached hereto and in accordance with the Contract Documents, including, but not limited to, Invitation to Bidders, Instructions to Bidders, General and Special Conditions of the Agreement, Plans, and other drawings and printed or written explanatory matter thereof, and the Technical Specifications, on file with Engineer. Contractor represents and warrants to the Owner that it has carefully examined this Agreement and all other

Contract Documents, which are made a part of the Contract, and is thoroughly familiar therewith.

The Contractor hereby agrees to begin work within **10 calendar days** after written Notice to Proceed has been given by Engineer. Contractor hereby also agrees to achieve Substantial Completion of the Work within **320 calendar days** after the date of the written Notice to Proceed and to achieve Final Completion of the Work within **365 calendar days** after the date of the written Notice to Proceed.

Owner agrees to pay Contractor for completion of the Work in accordance with the Contract Documents the initial Contract Price of _____ (\$_____), plus or minus any increases or decreases to the initial Contract Price as provided by the Contract. Contractor will be paid in current funds for the performance of the Contract in accordance with the Bid submitted therefor, subject to additions and deductions as approved by Change Order under the Contract Documents, and to make payments on account thereof as provided therein. If included as Attachment A, the Developer shall act as "Owner" for the purposes of payment.

IN WITNESS WHEREOF, the parties to these presents have executed this Agreement in the year and day first above written.

[EXECUTION PAGE FOLLOWS]

ATTEST: _____

CYPRESS FOREST P.U.D.
Owner

By: _____
Name: _____
Title: _____

ATTEST: _____

Contractor

By: _____
Name: _____
Title: _____

(The following to be executed if Contractor is a Corporation)

I, _____, certify that I am the secretary of the Corporation named as Contractor herein; that _____ who signed this Contract on behalf of Contractor, was then _____ of said Corporation; that said Contract was duly signed for and on behalf of said Corporation by authority of its governing body and is within the scope of its corporate powers.

Signed: _____

Corporate Seal

PERFORMANCE BOND

STATE OF TEXAS

Contract Date _____

COUNTY OF _____ Date Bond Executed _____

PRINCIPAL _____

SURETY _____

OWNER CYPRESS FOREST PUD

PENAL SUM OF BOND (in words and figures) _____,

being 100 percent of the Contract Price.

CONTRACT for _____ for CYPRESS FOREST PUD, _____ County, Texas (the "Contract").

KNOW ALL PERSONS BY THESE PRESENTS, that we, Principal and Surety above named, are held and firmly bound unto Owner, its successors and assigns, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves and our respective heirs, executors, administrators, officers, directors, shareholders, partners, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal entered into that certain Contract with Owner, which Contract is expressly incorporated herein for all purposes.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION IS SUCH, that if Principal well and truly performs the work in accordance with the plans, specifications and any other contract documents, during the original term of the Contract and any extensions thereof that may be granted by Owner, with or without notice to Surety, and during the life of any guaranty or warranty required under the Contract, then this obligation is void; otherwise it is to remain in full force and effect. Should the Principal fail to faithfully and strictly perform the work as required by the Contract in all its terms, the Surety will be liable for all damages, losses, expenses and liabilities that the Owner may suffer in consequence thereof.

This Bond is given in compliance with the provisions of Chapter 2253 of the Texas Government Code, as amended, which is incorporated herein by this reference. However, all of the express provisions contained herein and in the Contract are applicable whether or not within the scope of said statute.

Surety hereby agrees, for value received, that no change, extension of time, alteration or addition to the terms of the Contract or to work performed under the Contract, or to the plans, specifications or drawings accompanying the Contract, will in any way affect its obligations on this Bond and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder.

The bound parties have executed this instrument pursuant to authority of their respective governing body, to be effective on the same date of the Contract.

PRINCIPAL
By _____
Name _____
Title _____
Address _____

ATTEST

By _____
Name _____
Title _____

(SEAL)

SURETY
By _____
Name _____
Title _____

(SEAL)

ATTEST

By _____
Name _____
Title _____

Physical Address:

Mailing Address:

Telephone: _____

Local Recording Agent Personal Identification Number:

Agency Name: _____
Agency Address _____
Agency Telephone _____

Surety must attach its original Power of Attorney to this Bond.

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the secretary of the corporation named as Principal in the Bond; that _____, who signed the Bond on behalf of Principal, was then _____ of the corporation; that I know his or her signature, and his or her signature is genuine; and that the Bond was duly signed for and on behalf of the corporation by authority of its governing body.

Signature of Corporate Secretary

(Corporate Seal)

ATTACH POWER OF ATTORNEY

PAYMENT BOND

STATE OF TEXAS

Contract Date _____

COUNTY OF _____

Date Bond Executed _____

PRINCIPAL _____

SURETY _____

OWNER CYPRESS FOREST PUD

PENAL SUM OF BOND (in words and figures) _____,

being 100 percent of the Contract Price.

CONTRACT for _____ for CYPRESS FOREST PUD, _____ County, Texas.

KNOW ALL PERSONS BY THESE PRESENTS, that we, Principal and Surety above named, are held and firmly bound unto Owner, its successors and assigns, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves and our respective heirs, executors, administrators, officers, directors, shareholders, partners, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal entered into the Contract with Owner, which Contract is expressly incorporated herein for all purposes.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION IS SUCH, that if Principal shall promptly pay claimants for all labor, subcontracts, materials and specially fabricated materials performed or furnished under or by virtue of the Contract, and duly authorized modifications and normal and usual extras thereto, notice of which modifications to Surety being hereby waived, then this obligation shall be void, otherwise to remain in full force and effect. Should Principal fail to promptly pay claimants for all labor, subcontracts, materials and specially fabricated materials performed or furnished under or by virtue of the Contract, Surety is hereby bound to make such payments on behalf of Principal up to a total aggregate amount equal to the penal sum of the Bond. Labor, subcontracts, materials, and specially fabricated materials shall be construed in accordance with Chapter 2253, Texas Government Code.

PROVIDED, HOWEVER, that Owner having required Principal to furnish this Bond in order to comply with the provisions of Chapter 2253, Texas Government Code, all rights and remedies on this Bond shall inure solely to such claimants and shall be determined in accordance with the provisions, conditions, and limitations of the aforesaid Government Code to the same extent as if they were copied at length herein.

The bound parties have executed this instrument pursuant to authority of their respective governing body, to be effective on the same date of the Contract.

PRINCIPAL
By _____
Name _____
Title _____
Address _____

ATTEST
By _____
Name _____
Title _____
(SEAL)

SURETY
By _____
Name _____
Title _____
(SEAL)
ATTEST
By _____
Name _____
Title _____
Physical Address:

Mailing Address:

Telephone: _____

Local Recording Agent Personal Identification Number:

Agency Name: _____
Agency Address _____
Agency Telephone _____

Surety must attach its original Power of Attorney to this Bond.

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the secretary of the corporation named as Principal in the Bond; that _____, who signed the Bond on behalf of Principal, was then _____ of the corporation; that I know his or her signature, and his or her signature is genuine; and that the Bond was duly signed for and on behalf of the corporation by authority of its governing body.

Signature of Corporate Secretary

(Corporate Seal)

ATTACH POWER OF ATTORNEY

MAINTENANCE BOND

STATE OF TEXAS

Contract Date _____

COUNTY OF _____ Date Bond Executed _____

PRINCIPAL _____

SURETY _____

OWNER Cypress Forest PUD

PENAL SUM OF BOND (in words and figures) _____,

being 100 percent of the Contract Price.

CONTRACT for _____ for Cypress Forest PUD, _____ County, Texas (the "Contract").

KNOW ALL PERSONS BY THESE PRESENTS, that we, Principal and Surety above named, are held and firmly bound unto Owner, its successors and assigns, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves and our respective heirs, executors, administrators, officers, directors, shareholders, partners, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal entered into that certain Contract with Owner, which Contract is expressly incorporated herein for all purposes.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION IS SUCH, that if Principal well and truly repair any and all defects in the work occasioned by or resulting from defects in materials furnished by, or workmanship of, the Principal in performing the work covered by the Contract, including any guaranty or warranty required under the Contract, then this obligation is void; otherwise it is to remain in full force and effect. Should the Principal fail to well and truly repair any and all defects in the work occasioned by or resulting from defects in materials furnished by, or workmanship of, the Principal in performing the work as required by the Contract in all its terms, the Surety will be liable for all damages, losses, expenses and liabilities that the Owner may suffer in consequence thereof.

The parties intend this maintenance bond to be a common law bond to be constructed in accordance with Texas law.

Surety hereby agrees, for value received, that no change, extension of time, alteration or addition to the terms of the Contract or to work performed under the Contract, or to the plans, specifications or drawings accompanying the Contract, will in any way affect its obligations on this Bond and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder.

The bound parties have executed this instrument pursuant to authority of their respective governing body, to be effective on the same date of the Contract.

PRINCIPAL
By _____
Name _____
Title _____
Address _____

ATTEST
By _____
Name _____
Title _____
(SEAL)

SURETY
By _____
Name _____
Title _____
(SEAL)
ATTEST
By _____
Name _____
Title _____
Physical Address:

Mailing Address:

Telephone: _____

Local Recording Agent Personal Identification Number:

Agency Name: _____
Agency Address _____
Agency Telephone _____

Surety must attach its original Power of Attorney to this Bond.

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the secretary of the corporation named as Principal in the Bond; that _____, who signed the Bond on behalf of Principal, was then _____ of the corporation; that I know his or her signature, and his or her signature is genuine; and that the Bond was duly signed for and on behalf of the corporation by authority of its governing body.

Signature of Corporate Secretary

(Corporate Seal)

ATTACH POWER OF ATTORNEY

**SPECIAL CONDITIONS OF THE AGREEMENT
PART A**

I. BUILDER'S RISK INSURANCE OR INSTALLATION FLOATER INSURANCE

- A. Builder's Risk. Unless otherwise provided in the Agreement and before beginning the Work, Contractor shall purchase and maintain builder's risk insurance, if available, upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof from an insurer rated by Best's A- and VII or better. This insurance shall:
- i. include the Owner, Contractor, all Subcontractors, and any individuals or entities required by the Special Conditions to be insured under such builder's risk policy, as insureds. For purposes of the remainder of this Section I.A. through I.O., and any corresponding Special Conditions of the Agreement Part A, the parties required to be insured shall collectively be referred to as "insureds."
 - ii. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Special Conditions of the Agreement Part A. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - iii. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Agreement; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - iv. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
 - v. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or supplier).
 - vi. extend to cover damage or loss to insured property while in transit.

- vii. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- viii. allow for the waiver of the insurer's subrogation rights, as set forth below.
- ix. not include a co-insurance clause.
- x. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
- xi. include performance/hot testing and start-up.
- xii. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. **Installation Floater.** If builder's risk insurance is not generally available in the insurance marketplace for the Work, the Contractor shall obtain an installation floater insurance policy acceptable to Owner, or other acceptable equivalent policy as follows:

- ☐ No Installation Floater is required.
- ☒ The Installation Floater shall be in the amount of all installed, fabricated, or erected property being incorporated into the Work under the Contract.

Such policy shall cover all risks of physical loss or damage, including flood and earthquake, to the Work. Such coverage shall continue in full force and effect pursuant to Subparagraph I.A.xiii. The installation floater or equivalent policy shall name the Owner, Contractor, and any individuals or entities required by the Special Conditions to be insured under such installation floater, as insureds.

- C. **Contract with No Property.** Neither builder's risk insurance nor an installation floater is required under the Contract when the Engineer determines the Work does NOT involve installation, fabrication, or erection of any property, including but not limited to any fixtures, materials, or equipment, which could be covered under such policies. The risk of loss, however, still remains with the Contractor pursuant to the Contract Documents.
- D. **Insurance Certificates.** Before beginning the Work under this Agreement, Contractor shall furnish certificates of insurance to Owner with endorsements evidencing that the insurance required under this Section I is in full force and effect. Contractor shall provide new, replacement certificates, evidencing the procurement of successor policies, prior to the expiration of each required policy for so long as this Agreement is in effect.
- E. **Accuracy of Information.** Contractor warrants the accuracy of all information shown on each certificate furnished to Owner by Contractor or on Contractor's behalf by Contractor's broker or other representative.

- F. Notice of Cancellation or Change. The Builder's risk, installation floater and all the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Section I of the Special Conditions of the Agreement Part A will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least seven (7) days prior written notice has been given to the purchasing policyholder. Within three (3) days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- G. Deductibles. The purchaser of any required builder's risk, installation floater, or other property insurance shall pay all premiums and costs not covered because of the application of a policy deductible or self-insured retentions.
- H. Partial Occupancy or Use by Owner. If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the insurer. The builder's risk, installation floater, or equivalent policy of insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may be removed from coverage under the builder's risk policy, installation floater or equivalent policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance, installation floater, or equivalent policy.
- I. Additional Insurance. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk, installation floater, or other property insurance policies provided under this Section I of the Special Conditions of the Agreement Part A, it may do so at Contractor's expense.
- J. Insurance of Other Property. If the express insurance provisions of the Agreement do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount. The entity or individual procuring the insurance is responsible for payment of premiums.
- K. Non-Waiver - No Limitation of Owner's Rights. Contractor unilaterally agrees to comply with the provisions of this Section. Accordingly, Owner's knowledge concerning deficiencies in Contractor's insurance, including non-compliance with this Section shown by any insurance certificate or other information furnished to Owner, shall not affect Owner's rights and shall not result in a waiver or otherwise limit or impair Owner's remedies for Contractor's failure to comply with the requirements of this Section.
- L. No Impairment or Waiver of Rights. Nothing contained in this Section shall restrict, limit, impair or waive Owner's rights or Contractor's duties under the other terms of this Agreement or under applicable law. The cancellation, expiration, or exhaustion of any of the insurance required above shall not preclude Owner from recovery against Contractor for any liability arising under this Agreement or under law.
- M. Automatic Reformation to Conform to Law. The parties intend this Agreement to comply with Texas law. Accordingly, the parties agree that any legal limitations now or hereafter in

effect and affecting the validity or enforceability of any provision of this Agreement are made a part hereof and shall operate to amend this Agreement to the minimum extent necessary to bring all provisions into conformity with the requirements of such limitations and, as so modified, this Agreement shall continue in full force and effect.

N. Waiver of Rights.

- i. All policies purchased in accordance with this Section I of the Special Conditions of the Agreement Part A, expressly including the builder's risk policy and installation floater policy or equivalent policy, 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 insureds thereunder, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies to the extent of actual coverage under such policies; and, in addition, waive all such rights against all individuals or entities identified in the Special Conditions of the Agreement Part A as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- ii. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Special Conditions of the Agreement Part A as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance, installation floater and any other property insurance applicable to the Work.

O. Receipt and Application of Property Insurance Proceeds.

- i. Any insured loss under the builder's risk, installation floater or other policies of insurance required by this Section I of the Special Conditions of the Agreement Part A will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within fifteen (15) days after notice of such claim.
- ii. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause.

II. LIABILITY INSURANCE

- A. Insurance Certificates. In addition to the coverages described and required in Section I above and before beginning the Work under this Agreement, Contractor shall furnish certificates of insurance to Owner evidencing that the insurance required below is in force and effect. Contractor shall provide new, replacement certificates, evidencing the procurement of successor policies, prior to the expiration of each required policy for so long as this Agreement is in effect.
- B. Accuracy of Information. Contractor warrants the accuracy of all information shown on each certificate furnished to Owner by Contractor or on Contractor's behalf by Contractor's broker or other representative.
- C. Minimum Required Insurance and Minimum Limits of Liability. Before beginning the Work, and throughout performance of the Work and the term of this Agreement, Contractor shall obtain and maintain in force and effect, at Contractor's sole expense, insurance of the following types and amounts from insurance rated by Best's A- and VII or better:
- i. **Workers' Compensation Insurance** affording statutory benefits in accordance with all requirements of the Texas Workers' Compensation Act and covering Contractor's employees.
 - ii. **Employer's Liability Insurance** with limits of not less than \$1,000,000 per accident or disease.
 - iii. **Commercial General Liability Insurance**, including coverage for bodily injury and property damage, personal and advertising injury, the products-completed operations hazard, and insured contracts, applicable in Texas, on a form no less broad than the Insurance Services Office ("ISO") CG 00 01 form dated 2004 or thereafter, and with limits of not less than:
 - (1) Each Occurrence - \$1,000,000
 - (2) General Aggregate - \$2,000,000
 - (3) Products-Completed Operations Aggregate - \$2,000,000
 - (4) Personal & Advertising Injury -\$1,000,000
 - iv. **Business Automobile Liability Insurance**, including coverage for bodily injury and property damage, on a form no less broad than the ISO CA 00 01 form dated 2010 or thereafter, with limits of not less than \$1,000,000 combined single limit for each accident and covering owned, hired or leased, and non-owned autos.
 - v. **Excess or Umbrella Liability Insurance**, affording coverage no less broad than, and applying excess of the limits of liability, of the policies required by II.C.ii., II.C.iii., and II.C.iv., above, with limits of not less than \$2,000,000 per occurrence and in the aggregate.
- D. Additional Insurance or Limits. Paragraphs II.C, above, states the minimum types of liability insurance and limits of liability required by this Agreement in connection with the Work. Contractor may, in its sole discretion, procure additional insurance or higher limits of liability at Contractor's sole expense.

- E. Additional Insureds. To the extent allowed by law, the Commercial General Liability Insurance, Business Automobile Liability Insurance, and Excess or Umbrella Insurance required by II.C.iii., II.C.iv., and II.C.v., above, shall be endorsed to provide that the Indemnified Parties (collectively, “the Additional Insureds”), are added as additional insureds for liability arising out of the Work, to include liability based on either alleged fault or vicarious liability. Such additional insured coverage shall not be limited to liability caused by Contractor or Contractor’s fault. The Additional Insureds shall be afforded additional insured status on the policies required by paragraphs II.C.iii and II.C.v, above, under a combination of the ISO CG 20 10 10 01 and ISO CG 20 37 10 01 endorsements.
- F. Primary/Non-Contributing. The insurance policies required by II.C.iii., II.C.iv., and II.C.v., above, shall provide that the Additional Insureds are covered on a primary basis. Also, the insurance policies required by II.C.iii., II.C.iv., and II.C.v., above shall be endorsed to provide that Contractor’s insurers will not seek contribution or recovery from such other insurance as may be available to the Additional Insureds.
- G. Insurance Required of Contractor’s Subcontractors. Contractor shall require all subcontractors who will perform any of the Work to obtain the same insurance and limits of liability as required by II.C., above. Contractor shall also require all such subcontractors to cause their insurers to waive subrogation to the same extent as required of Contractor’s insurers by the following provision, H. Contractor shall obtain Certificates of Insurance from its subcontractors before they begin any of the Work and, upon request, shall provide copies thereof to Owner.
- H. Waiver of Subrogation in Favor of Indemnified Parties. The parties intend that none of Contractor’s insurers shall subrogate against the Indemnified Parties. Accordingly, Contractor agrees to cause all of its insurers—not limited to insurers underwriting the policies required above—to waive subrogation against the Indemnified Parties and its directors. **For the avoidance of doubt, Contractor also agrees that it presently waives and releases all rights of recovery, claims, or causes of action that might hereafter arise in favor of Contractor against Indemnified Parties for any loss, damage or liability that is covered by Contractor’s insurance, regardless of whether the loss, damage or liability is caused by the negligence, breach of any legal duty, or other fault of the Indemnified Parties.** The foregoing waiver and release is effective even if Contractor fails to obtain the required insurance.
- I. Notice of Cancellation, Modification or Impairment of Limits. The policies required above shall be endorsed to provide that they will not be canceled, or the coverage or limits of liability thereunder materially changed, without at least seven (7) days’ prior written notice to Owner.
- J. Notice of Impairment of Limits. Contractor shall give written notice to Owner no later than seven (7) days after the date on which an impairment of a required aggregate limit, due to the payment of a claim or defense expense, reduces the available aggregate limit to an amount 50% or less than the aggregate limit required above. If Contractor’s available excess insurance will not drop down and comply with paragraph II.C. of these insurance requirements, Owner may require reinstatement of an impaired aggregate limit up to the amount required.

- K. Information Concerning Contractor's Insurance Program. If Owner has questions concerning Contractor's casualty insurance program, Contractor agrees to promptly answer them. Complete, true and correct copies of each policy required above shall be furnished to Owner promptly upon Owner's request, but Contractor may redact payroll and premium information. Contractor agrees to cooperate with Owner, and with Owner's insurance broker, in the event Owner elects to seek or obtain additional insurance benefiting Owner. Contractor also provides Owner permission to communicate with Contractor's insurance broker regarding coverages required under the Contract Documents.
- L. Contractor's Compliance with Policy Conditions. Contractor shall comply with and not violate, or knowingly permit to be violated, any condition of the insurance policies required in these Special Conditions of the Agreement Part A. Contractor agrees to give its insurers timely written notice of all occurrences, accidents or claims arising out of the Work, with a copy to Owner.
- M. Contractor's Payment of Premiums, Deductibles and SIRs. Contractor, not Owner, shall be responsible for any and all policy premiums, deductibles, or self-insured retentions payable in connection with Contractor's insurance, including the insurance required above.
- N. Non-Waiver - No Limitation of Owner's Rights. Contractor unilaterally agrees to comply with the provisions of these Special Conditions of the Agreement Part A. Accordingly, Owner's knowledge concerning deficiencies in Contractor's insurance, including non-compliance with this Section shown by any insurance certificate or other information furnished to Owner, shall not affect Owner's rights and shall not result in a waiver or otherwise limit or impair Owner's remedies for Contractor's failure to comply with the requirements of this Section.
- O. No Impairment or Waiver of Rights. Nothing contained in these Special Conditions of the Agreement Part A shall restrict, limit, impair or waive Owner's rights or Contractor's duties under the other terms of this Agreement or under applicable law. The cancellation, expiration, or exhaustion of any of the insurance required above shall not preclude Owner from recovery against Contractor for any liability arising under this Agreement or under law.
- P. Automatic Reformation to Conform to Law. The parties intend this Agreement to comply with Texas law. Accordingly, the parties agree that any legal limitations now or hereafter in effect and affecting the validity or enforceability of any provision of this Agreement are made a part hereof and shall operate to amend this Agreement to the minimum extent necessary to bring all provisions into conformity with the requirements of such limitations and, as so modified, this Agreement shall continue in full force and effect.
- Q. Term of Insurance Requirements. All of the foregoing insurance requirements shall survive termination of this Agreement. All required insurance shall continue for at least thirty (30) days after final completion of the Work, to include performance of all warranty work.

III. WORKERS' COMPENSATION INSURANCE COVERAGE

A. Definitions.

- i. Certificate of Coverage ("Certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the Texas Workers' Compensation

- Commission, or a coverage agreement DWC-81, DWC-82, DWC-83, or DWC-84, showing statutory Workers' Compensation Insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.
- ii. **Duration of the Project** - Includes the time from the beginning of the Work on the Project until the Contractor's/person's Work on the Project has been completed and accepted by the governmental entity and the warranty period has expired.
 - iii. **Persons Providing Services on the Project ("Subcontractor" in §406.096 of the Texas Labor Code)** - Includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the Project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the Project.
 - iv. **"Services"** - Include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. Services does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.
- B. The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the Contractor providing Services on the project, for the duration of the Project.
 - C. The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the Contract.
 - D. If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the Project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.
 - E. The Contractor shall obtain from each person providing Services on a project, and provide to the governmental entity:
 - i. a certificate of coverage, prior to that person beginning Work on the Project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing Services on the Project; and
 - ii. no later than seven (7) days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.
 - F. The Contractor shall retain all required certificates of coverage for the duration of the Project and for one (1) year thereafter.

- G. The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing Services on the Project.
- H. The Contractor shall post on each Project site a notice, in the text, form, and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing Services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.
- I. The Contractor shall contractually require each person with whom it contracts to provide services on a Project, to:
- i. provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the Project, for the duration of the Project;
 - ii. provide to the Contractor, prior to that person beginning work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project;
 - iii. provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
 - iv. obtain from each other person with whom it contracts, and provide to the Contractor:
 - (1) a certificate of coverage, prior to the other person beginning work on the Project; and
 - (2) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
 - v. retain all required certificates of coverage on file for the duration of the Project and for one (1) year thereafter;
 - vi. notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project; and
 - vii. contractually require each person with whom it contracts, to perform as required by Paragraphs III.I.i through III.I.vi., with the certificates of coverage to be provided to the person for whom they are providing services.
- J. By signing this Contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the governmental entity that all employees of the Contractor who will provide Services on the project will be covered by Workers' Compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed

with the appropriate insurance carrier or, in the case of a self-insured, with the Commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

- K. The Contractor's failure to comply with any of these provisions is a breach of Contract by the Contractor which entitles the governmental entity to declare the Contract void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the governmental entity.

IV. **BONDS under INSTRUCTIONS TO BIDDERS** is revised to add the following:

It is further agreed by the Parties to this Contract that Contractor will execute the Bonds required under the Instructions to Bidders for the satisfactory performance of the Work, the fulfillment of any guarantees required, and the prompt payment to all persons supplying labor and materials in the prosecution of the Work, in accordance with this Contract on the forms provided for this purpose; and it is agreed that this Contract shall not be in effect until such **Bonds** are furnished and approved by Owner. Upon increase of the Contract Price authorized by Change Order, Contractor shall immediately provide revised **Bonds** for such increased Contract Price. Contractor's failure to provide compliant **Bonds** may be grounds for immediate termination regardless of whether the Contractor has started work on the Project.

All **Bonds** shall be in the form prescribed by the Contract Documents except as required 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 Bureau of Fiscal Service, Surety Bond Branch, United States Department of the Treasury. All **Bonds** signed by an agent must be accompanied by a certified copy of the agent's authority to act.

The person executing the bonds must be a licensed Texas local recording agent and such licensing must be recorded in the files of the Texas Department of Insurance.

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 herein Contractor shall promptly notify Contractor, Owner, and Engineer and shall, within ten (10) calendar days after the event giving rise to such notification, provide another **Bond** and surety to fulfill the required obligations.

- V. **PREVAILING WAGE RATE SCALE**. Chapter 2258 of the Texas Government Code provides that any political subdivision of the State of Texas shall ascertain the general prevailing wage rate received by the classes of workers employed on projects similar to this Project and shall specify in the call for bids and in the Contract the minimum wage rates which shall be paid for each type of Worker. This statute further provides that the Contractor or subcontractors shall pay a penalty to the Owner of Sixty Dollars (\$60) for each Worker employed for each calendar day or part for the day that the Worker is paid less than the wage rates stipulated in the Contract. The Owner is authorized to withhold from the Contractor the amount of this penalty from any payment due under the Contract.

The statute also requires that the Contractor and subcontractors keep an accurate record of the names and occupations of all persons employed by them in the construction of the Project and to

show the actual per diem wages paid to each Worker. These records shall be open to the inspection of the Owner.

The minimum wage rates that apply to this Contract are those shown in the Attachment.

VI. LIQUIDATED DAMAGES. The Contractor and the Owner agree that time is of the essence of this Contract. The Contractor and the Owner agree that a breach of this Contract by failure to complete the Work in the specified time will cause harm to the Owner, and further agree that the harm the Owner would sustain and the actual measure of damages the Owner would incur from the breach are incapable or very difficult of ascertainment. Therefore, the Contractor and the Owner agree that for each and every calendar day the Work or any portion thereof shall remain uncompleted after the expiration of the time limit(s) set in the Contract, or as extended under the provisions of these General Conditions (including, without limitation, due to a delay caused by Contractor's failure to comply with the Contract Documents or due to Owner's termination of Contractor for default under the Contract Documents), Contractor shall be liable to Owner for liquidated damages in the amount of [\$500] for each such calendar day, which sum the Parties agree is a reasonable forecast of the damages the Owner will sustain per day that the Work remains uncompleted and in no way constitutes a penalty. The Owner shall have the option to deduct and withhold said amount from any monies that the Owner owes the Contractor or its sureties or to recover such amount from the Contractor or the sureties on the Contractor's bond.

ECONOMIC DISINCENTIVE. The Contractor and the Owner agree that time is of the essence of this Contract. Therefore, the Contractor and the Owner agree that for each and every calendar day the Work or any portion thereof shall remain uncompleted after the expiration of the time limit(s) set in the Contract, or as extended under the provisions of these General Conditions (including, without limitation, due to a delay caused by Contractor's failure to comply with the Contract Documents or due to Owner's termination of Contractor for default under the Contract Documents), Contractor shall be liable to Owner for [\$500] day in economic disincentive damages pursuant to Section 49.271(e), Texas Water Code. Owner may elect to withhold Liquidated Damages or Economic Disincentive damages, but Owner may not collect on both Liquidated Damages and Economic Disincentive damages.

VII. WAIVER OF CHAPTER 2272 CLAIMS PROCEDURES. Owner and Contractor mutually agree that Chapter 2272 of Subtitle F, Title 10, of the Government Code ("Chapter 2272"), shall not apply to the Work. Owner and Contractor waive the application of Chapter 2272, if any, to the Contract. Instead, Owner and Contractor agree to follow the claims procedures in the General Conditions of the Contract Documents.

VIII. ARTICLE I. DEFINITIONS under GENERAL CONDITIONS is revised to add the following definitions:

Contracting Information means the following:

- (1) information in a voucher or contract relating to the receipt or expenditure of public funds by a governmental body;
- (2) solicitation or bid documents relating to a contract with a governmental body;
- (3) communications sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor during the solicitation, evaluation, or negotiation of a contract;
- (4) documents, including bid tabulations, showing the criteria by which a governmental body evaluates each vendor, contractor, potential vendor, or potential contractor

responding to a solicitation and, if applicable, an explanation of why the vendor or contractor was selected; and

- (5) communications and other information sent between a governmental body and a vendor or contractor related to the performance of a final contract with the governmental body or work performed on behalf of the governmental body.

IX. ARTICLE I. DEFINITIONS under GENERAL CONDITIONS is modified as follows:

The definition of Contract includes the Agreement and Contract Documents. The definition of Contract Documents includes the Contract. The Instructions to Bidders is a part of the Contract Documents.

X. ARTICLE II. CONTRACT DOCUMENTS under GENERAL CONDITIONS is revised to add the following section:

Section 2.02. CONTRACTING INFORMATION. If the Contract Price is equal to or greater than \$1,000,000, Contractor, pursuant to the Government Code Section 552.372, shall:

- (1) preserve all Contracting Information related to the Contract as provided by the records retention requirements applicable to the Owner for the duration of the Contract;
- (2) promptly provide to the Owner any Contracting Information related to the Contract that is in the custody or possession of the Contractor on request of the Owner; and
- (3) on Final Completion of the Contract, provide at no cost to Owner all Contracting Information related to the Contract that is in the custody or possession of the Contractor or preserve the Contracting Information related to this Contract as provided by the records retention requirements of the Owner.

The requirements of Subchapter J, Chapter 552, Government Code, may apply to this Bid and/or Contract and the Contractor agrees that the Contract can be terminated if the Contractor knowingly or intentionally fails to comply with a requirement of that subchapter.

XI. HOUSE BILL 89 VERIFICATION. By signing and entering into this Agreement, Contractor verifies, pursuant to the Government Code Section 2271.002, it does not boycott Israel and will not boycott Israel during the term of this Agreement.

XII. ANTI-TERRORISM VERIFICATION. Contractor hereby represents and warrants that at the time of this Agreement neither Contractor, nor any wholly owned subsidiary, majority-owned subsidiary, parent company or affiliate of Contractor: (i) engages in business with Iran, Sudan, or any foreign terrorist organization pursuant to Chapters 806 or 807 of the Texas Government Code, or Subchapter F of Chapter 2252 of the Texas Government Code; or (ii) is a company listed by the Texas Comptroller pursuant to Sections 806.051, 807.051, or 2252.153 of the Texas Government Code. The term “foreign terrorist organization” has the meaning assigned to such term pursuant to Section 2252.151 of the Texas Government Code.

ATTACHMENT A – PREVAILING WAGE RATE

ATTACHMENT A

CYPRESS FOREST PUBLIC UTILITY DISTRICT Prevailing Wage Rate Scale for Engineering Construction

Date: August 1, 2000

Classification	Wage Rate
Air Tool Operator	7.10
Asphalt Distributor	8.36
Asphalt Paving Machine	9.17
Asphalt Raker	7.57
Asphalt Shoveler	6.84
Batching Plant Weigher/Batching Plant Scaleman	9.43
Boatmen over 250 HP	8.30
Broom or Sweeper Operator	6.84
Bulldozer 150 HP or less	8.57
Bulldozer over 150 HP	9.15
Carpenter	10.35
Carpenter Helper Rough	7.48
Carpenter Rough	9.56
Concrete Curing Machine/Concrete Paving Curing Machine	8.31
Concrete Finisher Helper (Strs)	6.81
Concrete Finisher Helper Paving	6.50
Concrete Finisher Paving	8.92
Concrete Finisher Structures	8.96
Concrete Finishing Machine/Concrete Paving Finishing Machine	9.90
Concrete Joint Sealer/Concrete Paving Joint Sealer	9.18
Concrete Paving Float	9.30
Concrete Paving Form Grader	7.50
Concrete Paving Grinder	7.35
Concrete Paving Joint Machine	7.30
Concrete Paving Saw	8.74
Concrete Paving Spreader	8.62
Concrete Rubber	7.68
Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel less than 1-1/2 CY	9.57
Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel 1-1/2 CY and over	10.45
Crusher/Screening Plant	10.25
Deckhand	6.00
Electrician	14.67
Electrician Helper Junior	8.60
Electrician Helper Senior	10.25
Elevating Grader	8.00
Flagger	6.66
Form Builder Helper (Strs)	6.44

Classification	Wage Rate
Form Builder Structures	9.07
Form Liner Paving & Curb	8.36
Form Setter Helper (Pvg & Curb)	6.22
Form Setter Helper (Strs)	6.54
Form Setter Paving & Curb	7.90
Form Setter Structures	8.08
Found Drill Operator Helper (both)	7.75
Foundation Drill Operator Crawler Mounted	10.90
Foundation Drill Operator Truck Mounted	9.91
Front End Loader 2-1/2 CY and less	8.13
Front End Loader over 2-1/2 CY	8.83
Instrument Person	7.63
Laborer Common	6.20
Laborer Utility	7.18
Leverman	9.70
Line person	7.50
Manhole Builder	9.43
Manhole Builder Brick	7.67
Mate	8.00
Mechanic	10.58
Mechanic Helper	7.95
Milling Machine Operator	10.43
Mixer	7.94
Mixer Concrete Paving	8.00
Motor Grader	9.28
Motor Grader (Fine Grade)	9.93
Oiler	8.08
Painter Helper Structures	6.50
Painter Structures	12.00
Pavement Marking Machine	7.45
Paving Sub Grader	6.65
Piledriver	9.90
Pipe Layer	7.61
Pipelayer Helper	6.06
Pump Crete	7.35
Reinforcing Steel Setter Helper	6.64
Reinforcing Steel Setter Paving	8.89
Reinforcing Steel Setter Structures	9.94
Rod or Chainperson	6.58
Roller Pneumatic Self Propelled	7.10
Roller Steel Wheel Plant Mix Pavements	8.00
Roller Steelwheel Other Flatwheel or tamping	7.41
Roller Stl Whl Other	7.00
Scrapers 17 CY and less	7.63
Scrapers over 17 CY	8.03
Self Propelled Hammer Operator	7.80
Serviceman	7.60
Servicer	8.69
Sign Erector	9.53
Sign Erector Helper	6.00

Classification	Wage Rate
Sign Installer	7.45
Slipform Machine Operator	9.20
Spreader Box Operator	8.19
Steel Worker Structural	9.43
Steelworker Helper	6.90
Tractor Crawler Type 150 HP and less	8.91
Tractor Crawler Type over 150 HP	9.43
Tractor Pneumatic 80 HP and less	7.67
Tractor Pneumatic over 80 HP	8.50
Transit Mix	7.13
Traveling Mixer	7.93
Trenching Machine Heavy	13.56
Trenching Machine Light	9.00
Truck Driver Lowboy Float	9.35
Truck Driver Single Axle Light	7.21
Truck Driver Single Axle Heavy	7.72
Truck Driver Tandem Axle Semi-trailer	7.65
Wagon Drill, Boring Machine or Post Hole Driller Operator	9.83
Watch Engineer	8.94
Welder	9.35
Welder Helper	8.00
Winch	5.90
Work Zone Barricade	7.45

Note: This prevailing Wage Rate Scale for Engineering Construction does not prohibit the payment to workers of amounts greater than those specified herein.

**SPECIAL CONDITIONS OF THE AGREEMENT
PART B**

1. Name and Location of Project.

Work covered by these Technical Specifications is entitled “**Water Plant No. 2 Storm Damage Repairs in Cypress Forest Public Utility District in Harris County, Texas.**”

2. Description of Work.

- a. Under this Contract, Contractor shall furnish all materials, appliances, tools, equipment, transportation, services, and all labor and superintendence necessary for the construction of the Work as described in these Technical Specifications and as shown on the Plans. The completed installation shall not lack any part that can be reasonably implied as necessary to its proper functioning or any subsidiary item that is customarily furnished, and Contractor shall deliver the installation to Owner in operating condition.
- b. The Work, in general, under this Contract includes the purchase, installation, and construction of all structures, equipment, and materials, including appurtenances, as indicated on the Plans.

Major items of construction and services required are designated as follows:

- (1) Construction of a metal platform**
- (2) Installation of electrical equipment and components**
- (3) Installation of natural gas generator**
- (4) Relocation of chemical and electrical equipment within the existing building or onto new platform**
- (5) Site work**
- (6) Programming of electric and communication components**

3. Technical Specifications.

- a. Technical Specifications are of the abbreviated, simplified, or streamlined type and include incomplete sentences. The omission of words or phrases such as “Contractor shall,” “in conformity therewith,” “shall be,” “as noted on Plans,” “according to Plans,” “a,” “an,” “the,” and “all,” are intentional. Omitted words or phrases shall be supplied by inference in same manner as they are when a “note” occurs on Plans.
- b. The Technical Specifications are interpreted to require that Contractor shall provide all items, articles, materials, operation or methods listed, mentioned, or

scheduled either on Plans or specified herein, or both, including all labor, materials, equipment, and incidentals necessary and required for their completion.

- c. Whenever the words “designated,” “submitted,” “observed,” or similar words or phrases are used, it shall be assumed that the word “Engineer” follows the verb as the object of the clause, such as “observed by Engineer.”
- d. All references to standard Technical Specifications or manufacturer’s installation directions shall mean the latest edition thereof on the date BIDS are due unless specifically noted otherwise.
- e. Reference to technical society, organization, or body is made in Technical Specifications in accordance with following abbreviations:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
AWWA	American WaterWorks Association
FS	Federal Specifications
PCA	Portland Cement Association
IEEE	Institute of Electrical and Electronic Engineers
NEC	National Electric Code
UL	Underwriters’ Laboratories
AISI	American Iron and Steel Institute
API	American Petroleum Institute
IPCEA	Insulated Power Cable Engineers Association
NEMA	National Electrical Manufacturers Association
AWS	American Welding Society
PCI	Prestressed Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute (Formerly ASA)

- f. Some Technical Specification items cover construction requirements and materials in comprehensive manner, and only pertinent portions of these items apply.
4. Manufacturer’s Representative. When required by Technical Specifications provide the services of trained, qualified technicians to check final equipment installation, to assist as required in placing same in operation, and to instruct operating personnel in the proper manner of performing routine operation and maintenance of the equipment.

5. Plans.

<u>SHEET NO.</u>	<u>TITLE</u>
1 E-000	COVER PAGE
1A	HARRIS COUNTY EXPRESS REVIEW SHEET
2 E-001	ELECTRICAL ABBREVIATIONS, LEGENDS, AND GENERAL NOTES
3 E-002	SITE DEMOLITION PLAN
4 E-003	PUMP-CONTROL BUILDING DEMOLITION PLAN
5 E-004	WATER PLANT NO. 2 - ELEVATIONS AND GRADE SITE PLAN
6 E-005	PROPOSED WATER PLANT NO. 2 - FLOODWAY PLAN
7 E-100	PROPOSED ELECTRICAL SITE PLAN
8 E-110	PROPOSED ENLARGED ELECTRICAL PLAN
9 E-111	MCC CANOPY DETAILS
10 E-112	PROPOSED ELECTRICAL BUILDING PLAN
11 E-201	DEMOLITION ELECTRICAL ONE-LINE DIAGRAM
12 E-202	PROPOSED ELECTRICAL ONE-LINE DIAGRAM
13 E-301	ELECTRICAL SCHEDULES SHEET 1 OF 2
14 E-302	ELECTRICAL SCHEDULES SHEET 2 OF 2
15 E-400	ELECTRICAL MOTOR CONTROL CENTER ELEVATION
16 E-501	ELECTRICAL CONTROL DIAGRAMS SHEET 1 OF 4
17 E-502	ELECTRICAL CONTROL DIAGRAMS SHEET 2 OF 4
18 E-503	ELECTRICAL CONTROL DIAGRAMS SHEET 3 OF 4
19 E-504	ELECTRICAL CONTROL DIAGRAMS SHEET 4 OF 4
20 E-510	ELECTRICAL SOLID STATE CONTROLLER
21 E-601	ELECTRICAL DETAILS SHEET 1 OF 5
22 E-602	ELECTRICAL DETAILS SHEET 2 OF 5
23 E-603	ELECTRICAL DETAILS SHEET 3 OF 5
24 E-604	ELECTRICAL DETAILS SHEET 4 OF 5
25 E-605	ELECTRICAL DETAILS SHEET 5 OF 5
26 E-701	ELECTRICAL NATURAL GAS GENERATOR
27 S-101	ELECTRICAL EQUIP. SUPPORT PLATFORM STRUCTURAL SHEET 1 OF 3
28 S-102	ELECTRICAL EQUIP. SUPPORT PLATFORM STRUCTURAL SHEET 2 OF 3
29 S-103	ELECTRICAL EQUIP. SUPPORT PLATFORM CONC. STRUCTURAL SHEET 3 OF 3

SPECIAL PROVISIONS GOVERNING USE
OF PUBLIC ROADS AND STREETS

In the hauling of construction materials, excavation, equipment or other items required in the completion of this project, the attention of prospective bidders is directed to ordinances and regulations of local municipal or county governments which limit the type or the gross weight or motor vehicles or construction equipment operating on public roads and streets or which restrict the use of such equipment on certain streets.

It will be the responsibility of prospective bidders to investigate any limitations in routing, size of equipment, or gross vehicle WEIGHTS, WHICH may be subject to regulation by local governmental jurisdictions.

GENERAL CONDITIONS OF THE AGREEMENT

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GENERAL CONDITIONS OF THE AGREEMENT**ARTICLE I. DEFINITIONS**

- 1.01. DEFINITIONS. The following terms shall be defined as described below, unless such definition is expressly modified by the Contract Documents. Any capitalized terms used in the Contract Documents not defined in this section shall have the meaning assigned to such term under the Contract Documents.
- a. Bid. The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 - b. Bond(s). Performance bonds, maintenance bonds and payment bonds, or any of them, as required by the Contract Documents.
 - c. Change Order. A document signed by Contractor, Engineer and Owner and entered into in accordance with the Contract Documents that authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the time for completion.
 - d. Claim. A “Claim” is a claim, demand, or assertion by the Contractor seeking for itself or on behalf of a subcontractor or supplier: adjustment or interpretation of any Contract term, including without limitation, adjustment of the Contract Price or Contract Time; payment of money; relief from obligations; or other relief or recovery with respect to the terms of the Contract. The term “Claim” also includes other disputes and matters in question asserted by the Contractor (whether for itself or on behalf of a subcontractor or supplier) arising out of or relating to the Contract.
 - e. 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.
 - f. Contract Documents. The Invitation to Bidders, Instructions to Bidders, Bid, Agreement, General Conditions, Special Conditions, Technical Specifications, Plans, Change Orders, any written amendment to the Contract signed by both Contractor and Owner, Written Work Orders, written interpretations of the Contract or addenda issued by Engineer, and all other documents designated as incorporated by reference. Documents incorporated by reference are Contract Documents, whether attached or not. Approved Shop Drawings and other Contractor’s submittals, inspections and reports, such as testing of subsurface and physical or environmental conditions, are not Contract Documents.
 - g. Contractor. The entity with whom Owner has entered into this Contract.
 - h. Contractor Parties. The contractor, subcontractor, supplier and their respective agents, representatives or employees, or any of them.

- i. Contract Price. The amount of money stated in the Agreement as payable by Owner to Contractor for timely completion of the Work in accordance with the Contract Documents, plus or minus any increases or decreases to the initial Contract Price agreed to by Owner as provided by the Contract.
- j. Contract Time. The number of days or the dates stated in the Agreement to achieve Final Completion, expressed as a number of calendar days or as a reference to the date of Final Completion. If the Contract Time is measured by calendar days, each and every calendar day shall be counted against the Contract Time.
- k. Engineer. The design consultant so identified in the Agreement, or such other firm that Owner may designate, is herein called Engineer and 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.
- l. Extra Unit Price Items. All extra unit price items or alternate unit price items so specified in the Bid.
- m. Extra Work. All Work that may be required by Engineer or Owner to be done by Contractor to accomplish any change, alteration, or addition to the Work shown upon the Plans, implied by the Technical Specifications, or otherwise within the Contract Documents and not covered by Contractor's Bid. Notwithstanding the foregoing, Extra Unit Price Work required by Engineer or Owner as described herein is not included in the definition of Extra Work.
- n. Final Completion. The date on which the entire Work or an agreed portion thereof is complete in strict conformance with the Contract Documents. If any governmental entity has jurisdiction to approve or accept Contractor's work on the Project, or any portion thereof, Final Completion is not achieved unless and until written approval or acceptance of the entity is received.
- o. Force Majeure. Fire, flood, or act of God, earthquakes, hurricanes, tornadoes, epidemics, war, riot, civil disturbance, sabotage, terrorism, governmental or judicial restraint but only to the extent such event (i) is beyond the control of and cannot be reasonably anticipated by, or the effects alleviated by, the Contractor and (ii) prevents the performance of the Work. Events not specifically listed herein shall not constitute events of Force Majeure.
- p. Hazardous Environmental Condition. The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, Contaminants, 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.
- q. Indemnified Parties. Owner, and the officers, directors, employees, agents of Owner.
- r. Laws and Regulations. Any and all applicable federal, state and local laws, rules, regulations, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction and any and all rules of common law

pertaining to the Contractor's services, the Site, Contractor's employees and subcontractor's employees and/or the Work, and those of any other governmental entities with jurisdiction, including, without limitations all applicable laws of the State of Texas, Chapter 411 of the Texas Labor Code, Title VII (Equal Employment Opportunity) of the Civil Rights Act of 1964, The Occupational Safety and Health Act of 1970, The National Environmental Policy Act, The Federal Water Pollution Control Act, The Clean Air Act, The Clean Water Act, The Toxic Substance Control Act, The Resource Conservation and Recovery Act, and all amendments thereof. The agencies charged with the administration and enforcement of the Laws and Regulations include, but are not limited to, the Department of the Interior, the Equal Employment Opportunity Commission, the Occupational Safety and Health Administration, the Environmental Protection Agency, the U.S. Corps of Engineers, the National Fire Protection Association, the U.S. Geological Survey, the Minerals Management Service, the Texas Commission on Environmental Quality, the county in which the Owner is located, and the municipality, as applicable, in whose corporate or extraterritorial jurisdiction the Owner is located. Certain of the specific regulations that may be applicable to the Work are the Occupational Safety and Health Construction and General Industry Standards (29 CFR Part 1926 and 1910), and various environmental regulations.

- s. Notice to Proceed. A written notice given by or on behalf of Owner to Contractor fixing the date on which the Contract Time will begin to run and on which Contractor shall start to perform the Work.
- t. Owner. The entity so specified in the Agreement.
- u. Plans. That part of the Contract Documents which graphically shows the scope, extent, and character of the Work to be performed by Contractor.
- v. Project. The total construction on the Site, which may include work performed by the Owner or other contractors.
- w. Regulatory Agencies. Any and all governmental bodies, agencies, authorities, counties, municipalities, and courts having jurisdiction over the Project.
- x. Shop Drawing. 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.
- y. Site. The land or area furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access.
- z. Substantial Completion. The time at which the Work, or any portion thereof, is sufficiently completed in accordance with the Contract Documents so that Owner can occupy the entirety of the Work and put it to the full and unrestricted use for which it was intended, and all required certificates of occupancy and other permits, approvals, licenses, and documents required to occupy the Project by all entities, agencies and governmental authorities having jurisdiction over the Project and/or the operation and occupancy of the Project, as determined by the Engineer, have been given so that the

Project may operate for its intended purpose, although the Project may still require minor miscellaneous Work and adjustment. The Work will not be considered substantially complete if any Project systems included in the Work are not operational as designed and scheduled, if designated instructions of Owner, Engineer, or Owner's other representative in the operation of systems has not been completed, or any final finishes within the Contract Documents are not in place. The terms "substantially completed" or "substantially complete" as applied to all or part of the Work shall have the same meanings as set forth here.

- aa. Technical Specifications. That part of the Contract Documents, including any written addenda thereto, consisting of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
- bb. Work. All obligations of the Contractor under the Contract Documents and all equipment, materials, labor, construction, management, supervision, services, and activities of every kind and nature, whether commenced or not, or completed or partially completed, undertaken by the Contractor, provided or to be provided by the Contractor, required of the Contractor, or inferable from the Contract Documents to perform and fulfill all of the Contractor's obligations pursuant to the Contract Documents.
- cc. Written Work Order. A written statement to Contractor signed by Owner or Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions. A Written Work Order will not change the Contract Price or Contract Time, but is evidence that the parties expect that the Written Work Order will be incorporated in a subsequently issued Change Order following agreement by the parties as to its effect, if any, on the Contract Price or Contract Time.

ARTICLE II. CONTRACT DOCUMENTS

2.01. INTERPRETATION OF CONTRACT DOCUMENTS AND PHRASES.

- a. Whenever the words "required," "permitted," "designated," "considered necessary," "prescribed," or words of like import are used, it shall be understood that the requirement, permission, order, designation, or prescription of Engineer is intended and similarly, the words "approval," "acceptable," or "satisfactory," or words of like import shall mean approved by, or acceptable to, Engineer.
- b. Whenever in the Technical Specifications or Plans accompanying this Agreement, the terms or descriptions of various qualities relative to finish, workmanship, or other qualities of similar kind which cannot from their nature be specifically and clearly described and specified, are necessarily described in general terms, the fulfillment of which must depend on individual judgment, then, in all such cases, any question of the fulfillment of said judgment of said Technical Specifications or Plans shall be decided by Engineer, and said Work shall be done in accordance with his interpretations of the meaning of the words, terms, or clauses defining the character of the Work.

- c. The parties hereto agree that these Contract Documents shall not be construed against any party hereto on the basis that such party did or did not draft the Contract Documents.
- d. The section headings used herein are for convenience only and shall not affect the construction or terms hereof.
- e. If there is an irreconcilable conflict between Contract Documents, the document highest in precedence shall control, but except in such event and to avoid such conflict, every construction of provisions shall be that each is in aid to, or supplementary to or complementary of, each other provision, to control and secure for Owner the completion of the entire Work in an expeditious, orderly and coordinated manner. The precedence, from highest to lowest, shall be in the following order:
 - 1. Permits for the Work from governmental authorities as may be required by law;
 - 2. Agreement between Owner and Contractor;
 - 3. Special Conditions Part A;
 - 4. General Conditions;
 - 5. Special Conditions Part B Technical Specifications and Plans.

The most recently issued document takes precedence over previously issued forms of the same document. Modifications take precedence over applicable previously issued documents under items 2 through 5 above. Detailed drawings shall take precedence over general drawings. In the event of any discrepancies between the Plans and Technical Specifications, or likewise, in the event of any doubt as to the meaning and intent of any portion of the Contract, including the Technical Specifications or Plans, Engineer shall define that which is intended to apply to the Work.

- f. 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.
- 2.02. EXHIBITS. All Work shall be done and all materials furnished in strict conformity with the Contract Documents, all of which are hereto attached (or considered as if attached) and are hereby made a part of this Contract.
- 2.03. ACCURACY. These Contract Documents, including the Technical Specifications, Plans, and Bid, are intended to show all Work to be done and material to be furnished hereunder. Contractor understands and acknowledges that errors may exist in the Contract Documents and that the Owner does not warrant the accuracy or sufficiency thereof. The Contractor accepts any lack of completeness of the Contract Documents, including the Plans, Technical Specifications and Bid, and acknowledges that such documents were sufficiently detailed, accurate and comprehensive to enable Contractor to have adequately estimated and established the Contract Price and to perform the Work within the time for completion.

ARTICLE III. PRELIMINARY MATTERS

- 3.01. CONSTRUCTION SCHEDULE. The Contractor shall submit a construction schedule based on critical path method ("CPM") or other method specifically approved by the Engineer and that is sufficiently accurate during the entire Contract Time to determine if the Contractor is performing on schedule.

Within 10 days following the end of each month after Notice to Proceed, or at more frequent intervals when requested by Engineer, the Contractor shall submit an updated and revised schedule; the revision must be current as of the immediate past schedule period. Each element shall be updated to reflect the actual start and stop dates, actual duration and actual number of days worked, anticipated changes to future start and stop dates, and changes due to change in amount of Work or Contract Time. When requested by Engineer, the Contractor will submit only that portion of the CPM submittal required.

Failure to meet any schedule submission dates or to comply with any requested submittal or failure to provide an acceptable submittal will be cause to withhold payment of all or portions of the next scheduled monthly payment or any portions of future monthly payment until an acceptable submittal has been made.

As a minimum, the Contractor shall have available at least one individual with authority to maintain and revise the schedule as needed to reflect the actual and planned work schedule. This individual is to cooperate with Engineer's staff and be available to discuss schedule with Engineer's staff when requested.

- 3.02. SCHEDULE OF VALUES. If directed by Engineer within 10 calendar days following the Notice to Proceed, the Contractor shall submit, within 10 calendar days following such direction from Engineer, a schedule of values showing the subdivision of the Contract into various items of payment of construction. This schedule of values must state quantities and prices to the smallest common measurement, e.g., cubic yard, pound, linear feet, etc., and will be used as a basis for computing value to the Owner of Work to be paid for in partial payments. Except for work associated with prices bid as supplemental items listed in the Bid, the schedule of values also will be used to determine the value of like or similar work that may be added to or deleted from the Contract. The above-mentioned schedule of values must be in a format and of such detail to be acceptable to the Engineer. No partial payments will be made unless the schedule of values has been submitted by Contractor and accepted by the Engineer. Engineer may require that the schedule of values be cross-referenced to CPM with each item on schedule of values to show which CPM activity corresponds to or includes the item.
- 3.03. KEEPING PLANS AND SPECIFICATIONS ACCESSIBLE. Contractor shall be furnished with five copies of all Plans and Technical Specifications without expense to him, and shall keep one copy of each constantly accessible on the Site.
- 3.04. SALES TAX. Owner is exempt from Texas sales and use taxes pursuant to Texas Tax Code § 151.309 as a political subdivision of the State of Texas. Owner shall provide Contractor, if requested by Contractor in writing, with a completed Texas Sales and Use Tax Exemption Certification as evidence of the applicability of such exemption. Contractor shall not collect Texas sales and use taxes from Owner with respect to this Contract. Contractor and all

subcontractors to Contractor shall issue a Texas Sales and Use Tax Exemption Certification with respect to, and shall not pay Texas sales and use taxes on, all purchases of the following items that are exempt from Texas sales and use taxes pursuant to Texas Tax Code § 151.311: (i) tangible personal property that will be incorporated into Owner's realty; (ii) tangible personal property that is necessary and essential for the performance of this Contract and is consumed entirely on the job site; and (iii) taxable services for use in the performance of this Contract that are performed at the job site and are either integral to the performance of this Contract or expressly required to be provided by this Contract. In addition, Contractor and all subcontractors to Contractor (i) shall not include any provision for Texas sales and use taxes with respect to such exempt items in any bid or contract amount, and (ii) shall pass on to Owner cost savings due to the exempt status of such exempt items. Contractor's contracts with all subcontractors to Contractor shall include the foregoing provision regarding the exemption from Texas sales and use taxes. The Certification is included as Attachment A.

3.05. SHOP DRAWING SUBMITTALS.

- a. Shop Drawing Submittal List. Within 15 days after the date of the Notice to Proceed, Contractor shall submit for the Engineer's review a complete Shop Drawing submittal list. The list is to include Shop Drawings for all equipment and manufactured materials to be furnished under this Contract. The list should include, but not be limited to, the following, with each submittal to be numbered with a consecutive numbering system.

- i) Name (description) of submittal.
- ii) Applicable specification number or drawing number.
- iii) Scheduled submission date.
- iv) Latest date acceptable submittal required to prevent delay in purchase.

The Engineer may waive all or portions of the submittal requirements for any Shop Drawing on the submittal list. No payment will be made for the Work until the submittal list is accepted by the Engineer.

- b. Contractor's Duties. The Contractor shall review Shop Drawings prior to submittal to verify field measurements, field construction criteria, manufacturer model number and other pertinent data, to ensure conformance to Contract Documents, coordination with other submittals, and schedule for submittal and review.

The Contractor shall stamp and sign submittals with stamp which states "This submittal is certified to be in conformance with Contract Documents unless noted herein." All submittals without this certification will not be reviewed but will be returned to the Contractor for proper submission. The Engineer will rely on this statement when performing the review of the submittal.

The Contractor shall schedule submittals to allow sufficient time for review process and to coordinate submittals with the schedule to prevent delay to Work.

No Work may be performed in connection with fabrication, manufacturer, or purchase of materials or equipment until submittals have been reviewed and marked "No Exception Taken" or "Make Corrections Noted." Work performed on submittals marked "Make Corrections Noted" must be in accordance with all corrections noted thereon.

The Contractor shall correct submittals and resubmit or shall prepare new submittals for review by Engineer for all submitted items marked "Submit Specified Item," "Rejected," or "Revise and Resubmit." No claims for extra time or delays will be considered due to time required for review of submittals or resubmittals.

- c. Engineer's Duties. The Engineer shall review submittals as quickly as possible consistent with a thorough review and consistent with type of information submitted, but in any event not later than 14 calendar days from the date of submittal. Failure to comply with such review period shall not constitute the basis of a Claim.

Such review by the Engineer shall be for the sole purpose of determining the general conformity of said Shop Drawings or schedules to the Contract Documents and shall not relieve the Contractor of his duty as an independent contractor as set forth herein, it being expressly understood and agreed that the Engineer does not assume any duty to pass upon the propriety or adequacy of such drawings or schedules or any means or methods reflected thereby, in relation to the safety of either person or property during Contractor's performance hereunder. The Engineer's review of drawings will not constitute an acceptance of all dimensions, quantities, and details of the material, equipment, device, or item shown and does not relieve the Contractor from any responsibility for errors or deviations from the Contract requirements.

The Engineer shall clearly mark four copies of submittals with required corrections and shall stamp drawings noting the appropriate action, signature, and date.

- d. Form of Submittal. The Contractor must submit four copies of all submittals. One copy of the appropriately marked submittal will be retained at the Engineer's office, one copy will be retained at the Engineer's field office, and two copies will be returned to the Contractor for Contractor's use. The Engineer will not mark additional copies for the Contractor. If the Contractor desires additional copies, they must be marked by the Contractor.

The Contractor shall submit a complete copy of relevant Contract Document items which has been marked by the manufacturer to certify each point of the Contract Document item noting compliance and each point of deviation.

The Contractor must submit relevant literature, catalog cuts, or written descriptive matter backing up all points of the Contract Documents item compliance.

Contractor must submit comparative life cycle, cost, performance, or other data supporting consideration of all points of the Contract Documents item deviation.

All information supplied must be carefully and completely cross-referenced to the relevant Contract Document item requirement.

When required by an individual Contract Document item, the Contractor shall submit written step-by-step test plan for functional checkout and demonstration test of respective equipment. Submissions that do not conform to the form of submittal as outlined herein will not be considered and will be returned to the Contractor for proper submission.

The Contractor must have acceptable Shop Drawings at the Site. Failure of the Contractor to supply acceptable drawings will be deemed sufficient cause for Owner to delay the Work at Contractor's risk and expense until such drawings are available. This procedure shall not entitle Contractor to an extension of time.

- e. Installation Drawings. When required by individual items of the Technical Specifications, the Contractor shall provide, for the Engineer's use, two copies of installation drawings and instructions consisting of all necessary details required for field assembly, erection, and installation of a particular component of Work, including, but not limited to, unloading and storage instructions, layout/placement drawings, erection sequences, assembly drawings, connection details, and wiring diagrams.

- 3.06. VARIATIONS AND ALTERNATE DESIGNS. Foundations, structural supports, electrical work, and piping when shown on Plans for items of equipment may be changed if necessary to accommodate equipment furnished. Every effort has been made to design foundations, structural supports, electrical work, and piping so that no changes will be necessary; however, exact dimensions and size of subject foundations and structural supports and exact electrical and piping installations cannot be finally determined until various items of equipment are purchased and manufacturer's certified Shop Drawings are secured. Structural or electrical changes must be signed and sealed by a professional engineer licensed in the State of Texas. Contractor shall make required changes, after prior consultation with the Engineer, at no cost to Owner.

If substitute items of equipment are authorized which vary materially from those shown on Plans, Contractor shall prepare equipment data and detailed drawings covering necessary modifications and submit to the Engineer for approval. Contractor shall make drawings same size as Plans and of comparable quality. Contractor shall make payment of charges resulting from modifications including engineering charges for checking modifications.

If alternate design features are proposed for the convenience of the Contractor, the Contractor shall submit design calculations and detailed drawings covering proposed changes and related modifications of the Plans to the Engineer for review. Design calculations and detailed drawings submitted by the contractor must be signed and sealed by a professional engineer licensed in the State of Texas. The Contractor shall make drawings the same size as the Plans and of comparable quality. Contractor shall make payment of charges resulting from modifications, including engineering charges for checking such designs.

ARTICLE IV. SITE ACCESS/ CONDITIONS/ REFERENCE POINTS

- 4.01. ACCESS AND AVAILABILITY OF LANDS. Except as provided herein, the Owner shall provide, as indicated on the Plans, land upon which the Work is to be done, rights-of-way for access to same, and such other lands which are designated for use of the Contractor. If required, Contractor shall provide, at its own cost, for additional lands and access for temporary construction facilities or storage of materials and equipment.

Contractor shall propose, for Engineer's review and approval, access roads for moving construction personnel and equipment. The access routes are subject to change by the Engineer, occasioned by the progress of the Work or unforeseen conditions. If routes are changed, Contractor may propose alternate routes. Changes required in haul routes shall not be the basis for extra payment unless such changes are required by written directive from the Engineer.

Contractor shall, whenever possible, keep all construction traffic out of existing neighborhoods. Contractor shall keep haul routes clean at all times to the satisfaction of the Engineer and the local governing body having jurisdiction over the haul routes.

- 4.02. SURVEYING; LINES AND GRADES. The Owner will establish reference points for construction only; the Contractor is responsible for staking from bench marks and horizontal control references established by Engineer. The 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 Engineer. The Contractor shall report to the 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.

- 4.03. SOILS REPORT. If provided, any soils report and log of borings is available for Contractor's information only. The report is not a warranty of subsurface conditions, nor is it a part of the Contract Documents. Contractor is expected to examine the Site and such reports and then decide for itself the character of the materials to be encountered.

Owner and Engineer disclaim any responsibility for the accuracy, true location and extent of the surface and subsurface investigations that have been prepared by others. Owner and Engineer further disclaim responsibility for interpretation of that data by Contractor, i.e. projecting soil-bearing values, rock profiles, soil stability and the presence, level and extent of underground water or underground facilities.

- 4.04. SUBSURFACE EXPLORATION. It is not represented that the Plans show all existing storm sewer, sanitary sewer, water, gas, telephone and electrical facilities, and other underground structures. Contractor is to determine the location of these installations in the way of construction by referring to available records, consulting appropriate municipal departments and utility owners, and by making necessary exploration and excavations.
- 4.05. DEVIATIONS OCCASIONED BY UTILITY STRUCTURES. Whenever existing utilities, not indicated on the Plans, present obstructions to grade and alignment of pipe, Contractor shall immediately notify the Engineer who, without delay, will determine whenever existing

improvements are to be relocated or grade and alignment of pipe changed. Where necessary to move services, poles, guy wires, pipelines, or other obstructions, the Contractor will make arrangements with owners of utilities. The Owner will not be responsible for or liable for damages for any delays due to changes made by owners of utilities which hinder progress of work. The Owner may, at its discretion, determine whether to grant any extension of time.

- 4.06. DIFFERING SUBSURFACE OF PHYSICAL CONDITIONS. Contractor shall give prompt written notice to Engineer if any subsurface or physical condition is uncovered or revealed and either i) differs materially from that shown or indicated in the Contract Documents or the technical data or related documents or ii) is of a highly unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work performed at the location. After receipt of Contractor's written notice, Engineer will promptly review the condition, determine the necessity of Owner's obtaining additional exploration or tests and advise Owner in writing of Engineer's findings and conclusions. Contractor shall not further disturb such condition or perform any Work in connection therewith until receipt of written order from Engineer to do so. Absent an emergency, any Work performed by Contractor before receiving Engineer's response will be at the sole expense of the Contractor.

The Contract Price and/or the Contract Times may 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. Provided, however, Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if i) Contractor knew, or should have known, of the existence of such conditions at the time Contractor entered into the Contract; ii) 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 required by the Contract Documents to be conducted prior to Contractor's entering into the Contract; or iii) Contractor failed to give the written notice as required. If Owner and Contractor cannot agree on entitlement to, or the amount or extent of, any adjustment in the Contract Price or Contract Times, or both, a Claim may be made.

- 4.07. ARCHAEOLOGICAL OR HISTORICAL MATERIALS. On discovery of materials with potential archaeological or historical significance, the Contractor shall stop work and notify the Engineer. The Contractor shall protect the site from disturbance until it is cleared by the Engineer to resume work. The Contractor may receive damages for delay, limited to the actual costs of de-mobilization and re-mobilization, without mark-up, and may make a Claim for an extension to the Contract Time.

- 4.08. HAZARDOUS ENVIRONMENTAL CONDITIONS. Reports identifying Hazardous Environmental Condition are not Contract Documents. Owner and Engineer do not warrant the accuracy or completeness of such documents and disclaim all responsibility and liability for accuracy of investigations and reports prepared by third parties. Owner and Engineer also disclaim any responsibility for Contractor's interpretation of such reports and tests. 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; 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. Contractor shall not be required to resume Work in connection with such condition or in any affected area until the affected area is or has been rendered safe for the resumption of Work. Except as provided in this section, it will not be the Contractor's duty to provide any required governmental notifications relative to the discovery of Hazardous Environmental Conditions.

- 4.09. LOSSES FROM UNFORESEEN CIRCUMSTANCES AND CONDITIONS OR NATURAL CAUSES. Except as specifically provided in the Contract Documents, all loss or damage arising out of the nature of the Work to be done, or from the action of the elements, or from any unforeseen circumstances or natural causes in the prosecution of the same, or from the soil, subsurface, and other conditions, whether naturally occurring or manmade, or from concealed conditions or unusual obstructions or difficulties which may be encountered in the prosecution of the Work, shall be sustained and borne by Contractor at his own cost and expense. Contractor accepts such risk even for circumstances and conditions that differ materially from those indicated in the Contract Documents, geotechnical report, a review of the Site and surrounding areas or other information furnished by or on behalf of Owner. Accordingly, Contractor shall not be entitled to any additional compensation or time associated with unforeseen circumstances or conditions or natural causes.

ARTICLE V. CONTRACTOR'S RESPONSIBILITIES/ INDEMNITIES

- 5.01. INDEPENDENT CONTRACTOR. It is understood and agreed that all Work done by Contractor shall meet with the approval of Owner's representative but that the detailed manner and method of doing the Work shall be under the control of Contractor as set forth more fully in these General Conditions, Owner being interested only in the result obtained, and that Contractor is an independent contractor as to all Work performed hereunder.
- 5.02. TIME AND ORDER OF COMPLETION. It is the meaning and intent of this Contract, unless otherwise herein specifically provided, that Contractor shall be allowed to prosecute his Work at such times, in such order of precedence, and in such manner as shall be most conducive to economy of construction; provided, however, that:
- a. In all instances Contractor shall comply with the Contract Documents and the order, time, techniques, sequences, procedures, manner, means and methods of prosecution of the Work shall be such that the Work shall comply with and shall be substantially completed as a whole and in part, in accordance with the Contract Documents, including the Plans and Technical Specifications, and within the required time of completion, and Contractor shall have no right to perform any portion of the Work or utilize means, methods, techniques, sequences, procedures or individuals in violation of the Contract Documents or that may damage the Work or decrease the life expectancy of the Project.
 - b. The exercise of any of the rights and authority granted the Owner in the Contract Documents (including, without limitation, ordering changes in the Work, rejecting proposed means, methods, techniques, sequences or procedures, and directing suspension, rescheduling, re-execution or correction of the Work) shall not be construed as or deemed to be control of, charge of, or responsibility for or violation of Contractor's responsibility for and rights with respect to such construction means, methods, techniques, sequences, procedures, safety precautions and programs.

- c. When Owner is having other work done, either by contract or by his own force, Engineer may prescribe the time and sequence of constructing the Work done under this Contract so that conflict will be avoided and the various construction being done for Owner shall be harmonized.

With regard only to items a. and b. above, any additional schedules or charts furnished; acquisition of any necessary additional equipment; work of hours in excess of those encompassed within Contractor's normal workday; or performance of certain tasks whether similar or dissimilar to the foregoing shall be done without additional cost to Owner.

- 5.03. CONTRACTOR'S DUTY AND STANDARD OF CARE. Contractor is an independent contractor and shall give personal attention to the faithful prosecution and completion of the Work and shall be present either in person or by duly authorized representatives on the Site continuously during its progress. Contractor shall exercise a high degree of skill, care, and diligence in the performance of the Work. Contractor warrants that Contractor will (i) perform, supervise and direct the Work, using the Contractor's best skill and attention, in a good and workmanlike manner and in the best and most expeditious and economical manner consistent with the interests of the Owner, (ii) utilize his best skill, efforts and judgment in furthering the interests of the Owner, (iii) perform the Work in strict compliance with applicable Laws and Regulations, such that the Work, no later than the time for completion, will comply with applicable Laws and Regulations, and (iv) furnish efficient business administration and supervision (all of the foregoing collectively, the "Standard of Care"), and (v) perform the Work in strict accordance with the Contract Documents. If directed by the Engineer, he shall maintain an office on or adjacent to the Site. Regardless of what authority and rights may be assigned by the Owner to the Engineer, Contractor remains fully and solely responsible and liable for its obligations to perform the Work in strict accordance with the requirements of the Contract Documents; to insure against failures in safety precautions; to carry out the Work pursuant to safe methods of construction; to select and fulfill the proper manner, means, and methods in performing the Work in order to fully comply with the Plans, Specifications and other Contract Documents; and to otherwise complete the Work in accordance with the Contract Documents.
- 5.04. CONTRACTOR'S AGENT. Contractor, during his absence from the Site, shall keep a competent superintendent or foreman upon the Site, fully authorized to act for him in his absence. Contractor shall provide Engineer and Owner with written notification of such individual's position, name, and contact information. Any notice given by Engineer, when given to any superintendent, foreman, or agent of Contractor in charge of any operation of the Work in the absence of Contractor, shall be considered as notice to Contractor, provided any notice given under this paragraph shall be in writing.
- 5.05. CHARACTER OF WORKERS. Contractor agrees to employ only orderly, competent, and skillful people to do the Work; and agrees that whenever Owner shall inform him in writing that any person(s) or subcontractors on the Work are, in his opinion, incompetent, unfaithful, or disorderly, such person(s) or subcontractor shall be discharged from the Work and shall not again be employed on the Work without Owner's written consent.
- 5.06. CONSTRUCTION MATERIALS. Contractor shall provide all labor, tools, equipment, machinery, and material necessary in the prosecution and completion of this Contract, unless otherwise specifically provided. It is understood that Owner shall not be held responsible for

the care, preservation, conservation, or protection of any material, tools, or machinery or any part of the Work until it is finally completed and accepted. The Contractor shall incorporate into the Work only new materials and equipment and shall store these materials and equipment in manner to protect them from damage. The manner of protection is subject to specific approval of the Engineer. Pipe, fittings, equipment, and other serviceable materials found on the Site or dismantled by reason of construction shall remain property of the Owner unless otherwise designated. The Contractor shall remove and deliver materials to Owner at designated points and shall pay, at prevailing market price, for usable materials that are damaged through negligence.

- 5.07. OTHER CONTRACTS. Other construction may be underway concurrently in this area. The Contractor shall afford utility companies and other contractors reasonable opportunity for introduction and storage of their materials and execution of their work. All work under this Contract must be properly connected and coordinated with that constructed by others.
- 5.08. DAMAGES. In the event Owner is damaged in the course of the Work by the act, negligence, omission, mistake, or default of Contractor, or should Contractor delay the progress of the Work being done by others on the job so as to cause loss or liability to Owner, then Contractor shall reimburse Owner for such loss.

NOTWITHSTANDING ANY OTHER PROVISION OF THE CONTRACT DOCUMENTS, IN NO EVENT (INCLUDING, WITHOUT LIMITATION, DEFAULT BY OWNER), SHALL OWNER'S LIABILITIES, IF ANY, TO CONTRACTOR EVER EXCEED THE TOTAL CONTRACT PRICE, LESS ALL SUMS FOR WORK, MATERIALS AND/OR LABOR PREVIOUSLY PAID TO CONTRACTOR BY OWNER.

- 5.09. TITLE AND RISK OF LOSS. Although Contractor has custody and possession of the Work, as between Owner and Contractor, ownership and title to (as opposed to risk of loss of) all of the Work completed and in the course of construction at the Site and of all materials furnished irrespective of the location thereof, shall be in the name of the Owner. The vesting of such title in the Owner shall not impose any obligations on the Owner or relieve Contractor of any of its obligations hereunder. The Contractor warrants that it shall acquire no Work or equipment and materials, whether directly or through a subcontractor, subject to an agreement under which a security interest is retained by the seller or otherwise imposed by the Contractor, any subcontractor, or any other person or entity. Notwithstanding the passage of title, risk of loss or damage shall remain with Contractor until the Owner finally accepts the Work, unless otherwise specified in a certificate of Substantial Completion approved by the Owner.
- 5.10. PROTECTION OF PERSONS AND PROPERTY. Contractor shall at all times take reasonable precautions for the safety of its employees and of all other persons at the Site, and for the protection of adjacent property of others. Contractor shall comply with all applicable federal, state, and municipal safety laws and regulations and building and construction codes. All machinery and equipment and other physical hazards shall be guarded in accordance with the Manual of Accident Prevention in Construction of the Associated General Contractors of America unless such instructions are incompatible with Laws and Regulations. Where damage occurs on adjacent property, or where necessary to take down fences, signs, or other obstructions, Contractor shall repair, renew or replace in their original condition and restore damaged property or make satisfactory restitution to a condition equal to or better than that

which existed before Contractor caused the damage or removal, at no cost to Owner. Contractor shall promptly report to Engineer all accidents involving Contractor's employees or any other parties or property. Where livestock are present, Contractor shall take all necessary precautions to assure that no construction or construction related activity will allow livestock to leave their confine. Where existing fences are being crossed, Contractor shall maintain the integrity of the fence during construction through placement of guards, temporary fences, or other adequate measures as approved by the Engineer. All construction activities, including ingress and egress, shall occur within the boundaries and Contractor constraints of the temporary and permanent construction limits. Additionally, no staging, parking, loading and/or unloading shall occur outside of the designated construction limits.

5.11. INSURANCE AND BONDS. Contractor shall procure and maintain in force and effect during the Work the insurance described in the Special Conditions. It is further agreed by the parties to this Contract that Contractor will execute a Performance Bond, Maintenance Bond and/or Payment Bond, each as further specified in the Special Conditions.

5.12. INDEMNIFICATION OF OWNER. **TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR SHALL PROTECT, DEFEND, INDEMNIFY AND HOLD HARMLESS THE INDEMNIFIED PARTIES FROM AND AGAINST EVERY LOSS, ITEM OF DAMAGE, INJURY, EXPENSE, DEMAND, CLAIM, CAUSE OF ACTION, JUDGMENT OR LIABILITY, OF WHATSOEVER KIND OR CHARACTER, WHETHER ARISING IN CONTRACT OR TORT OR UNDER ANY STATUTE, FOR EVERY ELEMENT OF RECOVERY, WHETHER DIRECT OR INDIRECT, INCLUDING SPECIAL AND CONSEQUENTIAL DAMAGES, AND INCLUDING ALL RELATED FINES, FEES AND COSTS, TO INCLUDE ALL FEES AND CHARGES OF ENGINEERS, ARCHITECTS, ATTORNEYS AND OTHER PROFESSIONALS AND ALL COURT OR ARBITRATION OR OTHER DISPUTE RESOLUTION COSTS, FOR:**

(I) **BODILY INJURY OR DEATH OF AN EMPLOYEE OF ANY CONTRACTOR PARTIES, EVEN IF SUCH BODILY INJURY OR DEATH IS CAUSED IN WHOLE OR IN PART BY THE NEGLIGENCE, BREACH OF CONTRACT, BREACH OR VIOLATION OF A STATUTE, ORDINANCE, GOVERNMENTAL REGULATION, STANDARD, OR RULE, OR OTHER FAULT OF AN INDEMNIFIED PARTY;AND**

(II) **BODILY INJURY TO OR DEATH OF ANY PERSON NOT ENCOMPASSED IN (I), ABOVE, PROPERTY DAMAGE OR ECONOMIC LOSS (INCLUDING LOSS OF USE) CAUSED BY OR ARISING OUT OF ANY BREACH OF THIS CONTRACT, OR THE BREACH OF ANY COMMON LAW DUTY, OR THE VIOLATION OF ANY STATUTE OR REGULATION BY THE CONTRACTOR PARTIES IN CONNECTION WITH THE PERFORMANCE (OR NON-PERFORMANCE) OF THE WORK, IN EACH INSTANCE, EVEN IF DUE IN PART TO THE NEGLIGENCE, BREACH OF CONTRACT, BREACH OR VIOLATION OF A STATUTE, ORDINANCE, GOVERNMENTAL REGULATION, STANDARD, OR RULE, OR OTHER FAULT OF AN INDEMNIFIED PARTY, PROVIDED, HOWEVER, THAT CONTRACTOR'S OBLIGATION OF INDEMNIFICATION SHALL NOT EXTEND TO THE PERCENTAGE OF DAMAGES, INJURIES, EXPENSES,**

DEMANDS, CLAIMS, CAUSES OF ACTION, JUDGMENTS, LIABILITIES, COSTS AND FEES CAUSED BY THE INDEMNIFIED PARTIES.

THIS INDEMNITY AGREEMENT IS INTENDED TO MEET THE TEXAS “EXPRESS NEGLIGENCE RULE” BECAUSE CONTRACTOR AGREES THAT IT APPLIES AND IS ENFORCEABLE EVEN AS TO LOSSES, DAMAGES, INJURIES, EXPENSES, CLAIMS, CAUSES OF ACTION, JUDGMENTS OR LIABILITIES JOINTLY OR CONCURRENTLY CAUSED BY THE NEGLIGENCE OR OTHER FAULT OF THE INDEMNIFIED PARTIES. THE TERM “FAULT” IN THE PREVIOUS SENTENCE INCLUDES THE VIOLATION OR BREACH BY THE INDEMNIFIED PARTIES OF ANY COMMON LAW DUTY, ANY TERM OF THIS CONTRACT, OR ANY STATUTE OR REGULATION.

THIS INDEMNIFICATION OBLIGATION SHALL NOT BE LIMITED IN ANY WAY BY ANY OTHER PROVISION OF THIS CONTRACT OR BY ANY LIMITATIONS ON THE AMOUNT OR TYPE OF DAMAGES, COMPENSATION OR BENEFITS PAYABLE BY OR FOR THE CONTRACTOR PARTIES UNDER WORKERS’ COMPENSATION ACTS, DISABILITY BENEFIT ACTS OR OTHER EMPLOYEE BENEFITS ACTS.

THIS INDEMNIFICATION OBLIGATION IS IN ADDITION TO ALL OTHER LEGAL, EQUITABLE, OR INDEMNIFICATION REMEDIES AVAILABLE TO THE INDEMNIFIED PARTIES. THIS INDEMNIFICATION OBLIGATION SURVIVES THE TERMINATION OR EXPIRATION OF THIS CONTRACT.

In the event that any statute, rule of law or equitable principle should be held applicable to any indemnity clause contained in this Contract in favor of one or more of the Indemnified Parties which would render void, voidable, or unenforceable any such indemnity clause as to any party by reason of any provisions contained therein, then and in only such event, such indemnity clause shall be deemed modified and read, construed and enforced as to such party with respect to the provisions held to violate the statute, rule of law or equitable principle to require indemnity by Contractor of the Indemnified Parties to the fullest extent required by such indemnity provision modified and limited only to the degree or extent necessary to bring such indemnity into compliance with such statute, rule of law or equitable principle, but otherwise, the indemnity shall remain in full force and effect and binding upon the parties hereto.

Each party hereto agrees and covenants that it will not contest the validity or enforceability of any indemnity or exculpatory provision of this Contract on the basis that the party has no notice or knowledge of such provision or that the provision is not “conspicuous.”

If other provisions contain any indemnities or limitations, such indemnities shall be deemed to be cumulative of and to operate independently of the indemnities provided herein to the end that all indemnities provided in the Contract Documents shall be construed to grant indemnity to the Indemnified Parties to the fullest extent of each such indemnity.

Contractor shall include in each of its subcontracts with its subcontractors of every tier provisions the same as in all material respects those contained herein. Such provisions shall be for the benefit of and in favor of the Indemnified Parties and such other parties on whom Contractor and such subcontractors may agree.

5.13. INTELLECTUAL PROPERTY RIGHTS, COPYRIGHT AND INDEMNIFICATION.

- a. Contractor shall not furnish or provide to Owner any materials or Work that infringes a third party's intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, or the like). Contractor shall not disclose or provide to Owner any information, ideas, concepts, improvements, discoveries, inventions, or forms of expression of ideas which Contractor does not own or otherwise have the right to disclose or provide to Owner.
- b. Contractor represents and warrants that the materials and the Work shall be free from third party claims of ownership and that Owner's right to own, use, or otherwise disclose such materials and Work shall be free from third party claims of infringement of intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, trademark infringement or the like).
- c. Contractor represents and warrants to Owner that all information, ideas, concepts, improvements, discoveries, inventions, or forms of expression of ideas disclosed or provided to Owner shall be free from third party claims of ownership and that Owner's right to own, use, or otherwise disclose such information, ideas, concepts, improvements, discoveries, inventions, or forms of expression of ideas shall be free from third party claims of infringement of intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, trademark infringement or the like).
- d. Contractor represents and warrants that all processes or methods utilized by Contractor to provide it services to Owner are free from infringement of third party intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, or the like) and that all products provided by Contractor to Owner are free from third party claims of infringement of intellectual property rights, including allegations that the product infringes the claims of the United States process patent in violation of the Process Patents Amendment Act of 1988. Contractor shall cooperate fully and promptly with Owner with respect to any notice of infringement or request for disclosure or response to a request for disclosure generated or received by Owner in connection with Contractor's Work pursuant to the Process Patents Amendment Act of 1988. To the extent that Contractor obtains products from third parties which it intends to provide to Owner, Contractor shall obtain agreements from Contractor's vendors to cooperate in connection with requests for disclosure generated or received by Owner pursuant to the Process Patents Amendment Act of 1988.
- e. THE INDEMNITY AGREEMENT PROVIDED IN CONTRACTOR'S INDEMNITY OBLIGATION PROVIDED IN SECTION 5.12, ABOVE, INCLUDES, BUT IS NOT LIMITED TO THE FOLLOWING:

(I) CONTRACTOR'S BREACH OF ANY COVENANT, REPRESENTATION OR WARRANTY, WHETHER EXPRESS OR IMPLIED, REGARDING INTELLECTUAL PROPERTY RIGHTS; (II) ALLEGATIONS THAT OWNER, BY USE OF THE MATERIALS OR THE WORK, INFRINGES ANY THIRD PARTY'S INTELLECTUAL PROPERTY RIGHTS (WHETHER IT BE CLAIMS OF IMPROPER USE OF CONFIDENTIAL INFORMATION, PATENT INFRINGEMENT, COPYRIGHT INFRINGEMENT, TRADEMARK INFRINGEMENT OR THE LIKE); (III) ALLEGATIONS THAT A THIRD PARTY OWNS INFORMATION, IDEAS, CONCEPTS, IMPROVEMENTS, DISCOVERIES, INVENTIONS, OR FORMS OF EXPRESSION OF IDEAS, DESCRIBED OR PROVIDED BY CONTRACTOR TO OWNER; (IV) ALLEGATIONS THAT OWNER'S OWNERSHIP OR USE OF INFORMATION, IDEAS, CONCEPTS, IMPROVEMENTS, DISCOVERIES, INVENTIONS, OR FORMS OF EXPRESSION OF IDEAS DISCLOSED OR PROVIDED BY CONTRACTOR TO OWNER INFRINGE A THIRD PARTY'S INTELLECTUAL PROPERTY RIGHTS; (V) ALLEGATIONS THAT THE PROCESSES UTILIZED BY CONTRACTOR IN PROVIDING ITS SERVICES TO OWNER INFRINGE THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (INCLUDING A VIOLATION OF THE PROCESS PATENTS AMENDMENT ACT OF 1988); OR (VI) THE COSTS, AND EXPENSES, INCLUDING ATTORNEY'S FEES INCURRED BY OWNER, IN ENFORCING THE INTELLECTUAL PROPERTY INDEMNITY INCLUDED IN THIS PARAGRAPH.

IN ADDITION TO CONTRACTOR'S INDEMNITY OBLIGATION PROVIDED IN SECTION 5.12, ABOVE, TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR SHALL PROTECT, DEFEND, INDEMNIFY AND HOLD HARMLESS THE INDEMNIFIED PARTIES FROM AND AGAINST EVERY LOSS, ITEM OF DAMAGE, INJURY, EXPENSE, DEMAND, CLAIM, CAUSE OF ACTION, JUDGMENT OR LIABILITY, OF WHATSOEVER KIND OR CHARACTER, WHETHER ARISING IN CONTRACT OR TORT OR UNDER ANY STATUTE, FOR EVERY ELEMENT OF RECOVERY, WHETHER DIRECT OR INDIRECT, INCLUDING SPECIAL AND CONSEQUENTIAL DAMAGES, AND INCLUDING ALL RELATED FEES AND COSTS, TO INCLUDE ALL FEES AND CHARGES OF ENGINEERS, ARCHITECTS, ATTORNEYS AND OTHER PROFESSIONALS AND ALL COURT OR ARBITRATION OR OTHER DISPUTE RESOLUTION COSTS, BASED UPON, ARISING OUT OF, OR RELATING TO ANY ALLEGATION OF VIOLATION OF COPYRIGHT LAWS AS A RESULT OF CONTRACTOR'S PERFORMANCE (OR NON-PERFORMANCE) OF THE WORK AND EVEN IF DUE TO THE NEGLIGENCE, BREACH OF CONTRACT, VIOLATION OF STATUTE, OTHER FAULT OR LIABILITY WITHOUT REGARD TO FAULT OF ANY INDEMNIFIED PARTY.

- f. Contractor confirms and agrees that the Owner has and shall retain all rights, title, and interest in and to the drawings, documents, designs and information, including, without limitation, any copyright or other intellectual property rights, provided to Contractor or on behalf of Owner, and that by use of such drawings, documents, designs and information, the Contractor shall not acquire any right, title, or interest in

such drawings, documents, designs and information, including, without limitation, any copyright or other intellectual property rights. The Owner makes no representation or warranty, and hereby disclaims any such warranty, that any information provided to the Contractor by or on behalf of the Owner in connection with the Work is accurate, correct, sufficient, complete, fit for its intended purpose or can be used without infringing any intellectual property rights of third parties under any intellectual property rights of the world.

- 5.14. SUBCONTRACTOR'S ASSIGNMENT AND SUBLETTING. Contractor shall be fully responsible to Owner for all acts and omissions of any subcontractor, supplier, or other person or organization performing or furnishing any of the Work under a direct or indirect contract with Contractor. All Work performed for Contractor by such subcontractor, supplier, persons or organization shall be pursuant to an appropriate agreement between Contractor and each such party that specifically binds such party to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

Contractor shall timely pay its subcontractors and material suppliers, as required by law and any agreements between or among Contractor and its subcontractors/material suppliers, and such payments are a condition precedent to final payment.

- 5.15. CONTRACTOR'S SETTLEMENT OF CLAIMS. Contractor shall promptly settle or cause the settlement of all claims for which it is responsible, in whole or in part, pursuant to the Contract Documents. Upon receipt of any claim, Contractor shall immediately notify the Owner of the full particulars thereof, and the Owner may elect, by notice to Contractor, to have its representative accompany Contractor's representative in making settlement of the same.

- 5.16. SETTLING SMALL CLAIMS. Owner shall provide Contractor written notice of any claims made arising out of or relating to the Contract or the Contractor's performance of the Work. Contractor shall, within 10 calendar days following such notice, appoint in writing and thereafter, until Final Completion, unless earlier allowed by Owner, maintain on the Site a special agent who shall have full duty and authority on behalf of Contractor to settle and pay any claims payable by Contractor described herein, to request or confirm payment by Owner of such claims for the account of Contractor, and to do all other things necessary or convenient in connection with the foregoing authority. In addition, Contractor shall cause said special agent to accompany the representative of Owner to solicit the settlement of such claims as Owner's representative may request. Contractor, through his special agent, shall settle and pay claims payable by Contractor hereunder, but only in the presence and with the cooperation of the representative of the Owner, and in such settlement Contractor shall take receipts and releases in favor of and releasing the Indemnified Parties as well as Contractor.

Understanding that Owner has a special interest in preserving the good will of persons whose property may be injured in the course of the Work, should Contractor fail to settle and pay claims, including providing written receipts and releases in favor of and releasing the Indemnified Parties, within 30 calendar days of Owner's initial written notice, Owner shall thereafter have the rights and authority to itself settle and pay, on Contractor's behalf, such claims as described in this paragraph. Contractor expressly acknowledges, acquiesces and confirms that a representative of Owner may, in good faith, determine whether claims are payable in whole or in part by Contractor under the provisions herein (the hazard and

expense of litigation and the special interest of Owner in liquidating all Claims being considered), and if found so payable in part, the portion thereof properly payable by Contractor. To minimize the expense of employing agents in settling claims, Contractor hereby further authorizes Owner to settle and pay any claims payable by Contractor hereunder which may be settled for up to \$10,000 per claim (or such greater amount per claim as Contractor may fix by written notice to Owner). The amount of any such claims may be withheld from Contractor's final payment. Owner will use diligence in undertaking the settlement and payment of any such claims.

Contractor shall reimburse Owner for all costs and expenses incurred by Owner in the settlement of any claims payable by Contractor.

- 5.17. CONTRACTOR'S USE OF OWNER'S PROPERTY. In the event that any arrangement is made whereby Contractor or any of its subcontractors of any tier use any employees of Owner, any tools, equipment, apparatus, improvements or other personal property of Owner or any utilities (such as electricity, gas, water, compressed air and toilet facilities) furnished by or through Owner, irrespective of who pays the employees and regardless of whether any consideration is paid for the use of the tools or the utilities, then the employees while engaged in the use of the tools or the utilities shall be conclusively considered the agents, servants, and employees of Contractor, and the acceptance and/or use of the tools or the utilities by Contractor or its subcontractors of every tier shall mean the Contractor has inspected and determined the tools and utilities satisfactory for Contractor's intended purposes and uses, and accepted full responsibility for the tools and utilities. Owner makes no representation or warranty regarding the condition or suitability of any such tools, equipment, apparatus, improvements, other property or utilities. Contractor shall return the tools at the conclusion of Contractor's use thereof in the same condition as when received, ordinary wear and tear excepted.

5.18. LAWS AND REGULATIONS.

- a. Prior to beginning the Work, Contractor shall become familiar with all of the Laws and Regulations relating to the Work or which in any manner might affect the Work, and shall thereafter comply with all such Laws and Regulations. Contractor shall, at its expense, obtain all permits, licenses, certificates and other authorizations required by or reasonably necessary in connection with the Work and shall at all times observe and comply with the Laws and Regulations.
- b. Contractor agrees that all financial settlements, billings, and reports rendered to Owner as provided for in the Contract Documents will, to the best of its knowledge and belief, reflect properly the facts about all activities and transactions handled for the account of Owner, which data may be relied upon as being complete and accurate in any further recording and reporting made by Owner for whatever purpose.
- c. Contractor agrees to notify Owner promptly upon discovery of any instance where the Contractor fails to comply with provision (a) above or where Contractor has reason to believe data covered by (b) above is no longer accurate and complete.

- 5.19. BUSINESS STANDARDS. Contractor, in performing its obligations under Contract, shall establish and maintain appropriate business standards, procedures, and controls, including

those necessary to avoid any real or apparent impropriety or adverse impact on the interests of the Owner. Contractor shall review with the Owner at reasonable frequency during the performance of the Work hereunder, such business standards and procedures including, without limitation, those related to the activities of Contractor's employees and agents in their relations with the Owner's employees, agents, and representatives, vendors, subcontractors and other third parties, and those relating to the placement and administration of purchase orders and subcontracts.

In connection with this Contract and the Work, neither Contractor, its subcontractors of every tier, nor the employees, representatives, and agents of Contractor or any such subcontractor shall at any time solicit, accept, offer or bestow gratuities of more than nominal value from or to one or more of the Indemnified Parties, any of Owner's other contractors associated with the Work, the employees, agents, or representatives of such other contractors, or anyone else associated with the Work. Violation of this policy by Contractor or any subcontractor shall constitute a material breach of Contractor's obligations under the Contract Documents that may result at the Owner's election in a declaration of default.

5.20. SAFETY.

- a. Contractor shall develop a safety program applicable to each job site and to the Work to be done and enforce such program at all times. Further, Contractor shall comply with all applicable Laws and Regulations including, but not limited to, the standards and regulations promulgated by the Secretary of Labor under the Occupational Safety and Health Act of 1970 (OSHA) and any other legislation enacted for the safety and health of Contractor employees. Contractor shall have complete responsibility for protecting the safety and health of its employees, subcontractors, and all other persons.
- b. Contractor shall notify Owner immediately by telephone, with prompt confirmation in writing, of injuries and fatalities that occur on the Site in connection with any Work being performed under this Contract and shall provide Owner with such reports of injuries and fatalities as Owner shall deem necessary, including but not limited to, copies of all reports or other documents filed or provided to Contractor's insurers or the State of Texas in connection with such injury or fatality.
- c. Nothing contained herein shall be interpreted as enlarging Owner's legal duty to Contractor or to Contractor's agents, employees, subcontractors, or third parties, or altering the status of Contractor as an independent Contractor.

5.21. ALCOHOL, DRUGS, WEAPONS, ETC. The use of alcohol or controlled substances by any person on Owner's property or the Site or any person remaining on Owner's property or the Site under the influence of such substances is strictly prohibited. In addition, possession of alcohol, controlled substances, firearms, explosives, weapons, and hazardous substances or articles without proper authorization is not permitted on Owner's property or the Site. Entry onto Owner's property is deemed to be consent to and recognition of the right of Owner or a representative of the Owner who has been specifically authorized to search the person, motor vehicles, and other property of each individual while entering, on, or departing the Site.

- 5.22. UTILITY SERVICES FOR CONSTRUCTION. The Contractor shall provide all utilities necessary for construction at no additional cost to Owner unless otherwise specified in the Contract Documents.
- 5.23. OPERATION AND MAINTENANCE MANUALS. Operation and maintenance manuals are to be provided where required by an item in the Technical Specifications. The Contractor is responsible for obtaining installation, operation, and maintenance manuals from manufacturers and suppliers for equipment furnished under the Contract and shall submit three copies of each complete manual and one CD to the Engineer within 90 days after approval of Shop Drawings, product data, and samples, and not later than the date of shipment of each item of equipment to the Site or storage location. Operations and maintenance manuals specified hereinafter are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start up equipment.
- Each manual must be bound in a folder and labeled to identify the contents and project to which it applies. The Engineer may additionally request electronic copies of each manual, stored on electronic media suitable to the Engineer. The manual should contain the following:
- a. An 8-1/2-inch x 11-inch typewritten sheet listing the manufacturer's identification, including order number, model, and serial number and location of parts and service centers.
 - b. A separate 8-1/2-inch x 11-inch typewritten list of recommended stock of parts, including part number and quantity.
 - c. Complete replacement parts list.
 - d. Performance data and rating tables.
 - e. Specific instructions for installation, operation, adjustment, and maintenance.
- 5.24. INTERRUPTION OF UTILITY SERVICES. The Contractor shall not operate any valve or other control on existing systems. The Contractor shall exercise care in performing work so as not to interrupt service, including, but not limited to, locating and uncovering existing utilities ahead of heavy excavation equipment and at house connections, either lifting trenching machine over lines or cutting and reconnecting with minimum interruption of service, as approved.
- 5.25. TRAFFIC SAFETY MEASURES. If the Work occurs on or adjacent to any street, alley, or public place or where construction creates hazard to traffic or public safety, the Contractor shall furnish and maintain suitable barricades, warning signs, and lights and remove same when no longer necessary. The Contractor shall be responsible for all phases of traffic control according to the guidelines as set forth in Manual on Uniform Traffic Control Devices.
- 5.26. USE OF STREETS. Except where approved otherwise, the Contractor may not hinder or inconvenience travel on streets or intersecting alleys for more than two blocks at any one time. Whenever streets are closed the Contractor shall place properly worded signs announcing such fact to the public, with proper barricades at the nearest street corners, on

both sides of obstruction. The Contractor shall leave no street or driveway blocked at night. When streets are closed, Contractor shall also notify the Engineer, the Fire Department and the Police Department. The Contractor shall not block ditches, inlets, fire hydrants, etc., and, where necessary, shall provide temporary drainage.

The Contractor shall remove as soon as practicable, accumulated rubbish and open each block for public use. Use of any portion of a street shall not constitute acceptance of any portion of Work. The Contractor shall backfill and shape trenches across street intersections or driveways for safe traffic at night or, where permitted, span open trenches with steel plates or bridges to permit traffic flow. When driveways are cut, the immediate placement of mats for ingress or egress of vehicles may be directed if undue hardship to property owner would otherwise result.

- 5.27. CONSTRUCTION STORMWATER DISCHARGES. The Contractor shall, without any additional expense to the Owner, be responsible for obtaining any necessary licenses and permits and for complying with all applicable Laws and Regulations, including, but not limited to, any Laws or Regulations concerning storm water permitting and management. Specifically, without limitation, the Contractor will comply with all aspects of the Texas Pollutant Discharge elimination System ("TPDES") General Permit for Storm Water Discharges from Construction Activities in Texas and with the Storm Water Pollution Prevention Plan (SWPPP) that has been developed for the Project. At Owner's expense, the baseline SWPPP for the Project will be provided by the Engineer to Contractor. The Contractor will implement the baseline SWPPP and advise the Engineer in writing prior to implementing any changes required to the SWPPP due to changes in construction activities. The Engineer may update SWPPP due to changes in construction activities. The Contractor will file the Notice of Intent ("NOI") for permit coverage with the Texas Commission on Environmental Quality and will maintain a copy thereof, file stamped by such governmental authority, at the Site. Weekly inspection to ensure compliance with the SWPPP and other permit requirements will be performed by the Contractor. Upon Final Completion, the Contractor shall file the Notice of Termination ("NOT") with the Texas Commission on Environmental Quality.

The Contractor, and not the Owner, shall be responsible for any and all monetary fines or damages assessed by any governing agency resulting from the failure to comply with the requirements of the SWPPP.

- 5.28. SITE MAINTENANCE AND CLEAN-UP. Contractor shall maintain the Site during construction to keep it reasonably neat and free of trash, rubbish, and other debris. In clean-up operations, Contractor shall remove from the Site and from public and private property temporary structures, rubbish, and waste materials and dispose of excavated materials beyond that needed to bring the Site to elevations shown. During final clean-up, any road constructed by Contractor for access to the Site must be leveled and ruts filled so that surface drainage is not hindered.
- 5.29. AS-BUILT DIMENSIONS/ RECORD DRAWINGS. The Contractor shall make daily measurements of facilities constructed and keep accurate records of location (horizontal and vertical) of all facilities. Upon completion of Work, the Contractor shall furnish Owner with one set of direct prints, marked with red pencil, to show as-built dimensions and location of all Work constructed.

- 5.30. SANITATION. Necessary sanitary conveniences for the use of laborers on the Work, properly secluded from public observation, shall be constructed and maintained by Contractor, in such manner and at such point as shall be approved by Owner, and their use shall be strictly enforced.
- 5.31. CONTRACTOR'S BUILDINGS. The building of structures for housing men, or the erection of tents or other forms of protection will be permitted only at such places as Owner shall prescribe, and the sanitary conditions of the grounds in or about such structures shall at all times be maintained in a manner satisfactory to Owner.

ARTICLE VI. ENGINEER'S STATUS DURING CONSTRUCTION

- 6.01. ENGINEER'S AUTHORITY AND DUTY. It is mutually agreed between the parties to this Contract that: Engineer will act as Owner's representative during the construction of the Project, and that no act or omission on the part of Engineer, his subordinates or representatives, will excuse Contractor from full and proper performance of this Contract according to its terms, or give rise to any liability or obligation from Engineer to Contractor. All authority and rights assigned by the Owner to the Engineer with respect to the Work are solely and exclusively for the benefit of the Owner and not for the Contractor. The Engineer shall have no liability to Contractor under these Contract Documents in the absence of actual fraud.

To prevent delays and disputes and to discourage litigation, it is further agreed by and between the parties to the Contract that, if it cannot be otherwise agreed, Engineer shall in all cases determine the amounts and quantities of the several kinds of Work which are to be paid for under this Contract, and he shall determine all questions in relation to said Work and the construction thereof, and he shall in all cases decide every question which may arise relative to the performance of this Contract on the part of Contractor; provided, however, that should Engineer render any decision or make any requirement which, in the opinion of either party hereto, is not in accordance with the meaning and intent of this Contract, either party may file with Engineer within 30 calendar days his written objection to the decision or requirement so rendered. Contractor's failure to object to Engineer's decision or requirement within such 30 calendar days shall be deemed Contractor's agreement with such decision or requirement and constitute a waiver of any right of Contractor to additional time, compensation or damages as a result of such decision or requirement. It is the intent of this Contract that there shall be no delay in the performance of the Work. To this end, the decision or requirement of Engineer shall be promptly carried out. Engineer shall, within a reasonable time or as otherwise required in the Contract Documents, render and deliver to both Owner and Contractor a written decision on all claims of the parties hereto and on all questions that may arise relative to the execution of the Work or the interpretation of the Contract, Technical Specifications, or Plans.

- 6.02. EXAMINATION, OBSERVATION, AND TESTING. It is agreed by Contractor that Engineer shall be and is hereby authorized to appoint from time to time such subordinate engineers or project representatives as Owner may deem proper to examine the material furnished and observe the Work done and to ascertain whether the said material is furnished and said Work is done in accordance with the Contract Documents there for. Contractor shall furnish all reasonable aid and assistance required by the subordinate engineers or project representatives for the proper examination and testing of the Work and materials. The

authority of subordinate engineers and project representatives shall be limited to examination, observation, and testing of Work and materials, and reporting same to Engineer.

- 6.03. PRELIMINARY APPROVAL. Neither Engineer nor his subordinates shall have any power to waive the obligations of this Contract for the furnishing by Contractor of good material, or for his performance of good Work as herein described and in full accordance with the Plans, Technical Specifications, and other Contract Documents. No action taken or thing done, written or oral, including, but not limited to, inspections made, payments made, or Final Completion of the Work, and no failure or omission of Engineer or his subordinates to discover, object to, or condemn any defective Work or material, shall release Contractor from the obligation to fully and properly perform the Contract, including, without limitation, the obligation to at once tear out, remove, and properly replace the same.

Any questioned Work may be ordered by Engineer to be taken up or removed for re-examination prior to final acceptance, and if found not in accordance with the Contract Documents for said Work, all expense of removing, reexamination, and replacement shall be borne by Contractor; cost of uncovering any Work will be borne by Owner only when the Work is found acceptable and the Work was originally performed with the knowledge of the Engineer.

- 6.04. RIGHT OF ENGINEER TO MODIFY METHODS AND EQUIPMENT. The Contractor shall provide and use accepted equipment and materials in sufficient qualities and quantities to facilitate diligent prosecution of the Work to the end that the Work will be completed within the time for completion and otherwise in accordance with the Contract Documents. If at any time Engineer shall find that the methods, materials or equipment used by Contractor are faulty or inadequate to secure the quality of Work or the rate of progress necessary for Contractor to complete the Work (or any portion thereof) within the time period required by this Contract or otherwise will prevent the Work from being completed in accordance with the Contract Documents, Engineer may, in writing, require Contractor to improve their character and efficiency, replace and/or supplement them, and Contractor shall comply with such requirements.

If at any time the working force of Contractor is inadequate for securing the progress herein specified, Contractor shall, if so notified in writing, increase his force or equipment, or both, to such an extent as to ensure compliance with the schedule of progress (and timely completion of the Work) all in accordance with the Contract Documents.

ARTICLE VII. EXTRA WORK/ CHANGE ORDERS/ CLAIMS

- 7.01. CHANGES AND ALTERATIONS. Contractor further agrees that Owner may make such changes and alterations as Owner may see fit in the line, grade, form, dimensions, Plans, Technical Specifications, or materials for or scope of the Work herein contemplated, or any part thereof, either before or after the beginning of the construction, without affecting the validity of this Contract and the accompanying Bonds.

If such changes or alterations diminish the quantity of the Work to be done, such changes may reduce the Contract Price according to the quantity of Work actually done and the unit price established for such Work under this Contract and shall not constitute the basis for a Claim. If such changes or alterations increase the amount of Work and the increased Work

can fairly be classified under the Plans, Technical Specifications, or other Contract Documents, such increase shall be paid for according to the quantity of Work actually done and at the unit price established for such Work under this Contract; otherwise such Extra Work shall be paid for as provided in this Article. If Owner makes such changes or alterations as makes useless any Work already done or materials already furnished or used in accordance with the Contract Documents in connection with said Work, then Owner shall recompense Contractor for such Work, labor and materials, in accordance with the prices therefore in the Contract Documents, made useless by such change.

- 7.02. **EXTRA WORK.** It is agreed that Contractor shall perform all Extra Work when presented with a Written Work Order or Change Order. **The Contract Price for Extra Work may be changed only by a Change Order signed by Owner, Engineer and Contractor.** It is agreed that pricing in any Change Order for performing Extra Work shall be determined by one or more of the following methods:

Method (A) - By agreed unit prices; or

Method (B) - By agreed lump sum; or

Method (C) - If neither Method (A) nor Method (B) be agreed upon before the Extra Work is commenced, then Contractor shall be paid the “actual field cost” of the Extra Work, less any savings attributable to the change, alteration or addition, plus 15 percent of the net amount.

In the event said Extra Work be performed and paid for under Method (C), then the provisions of this paragraph shall apply and the “actual field cost” is hereby defined to include the cost of all workmen, such as foremen, timekeepers, mechanics, and laborers, and all materials, supplies, teams, trucks, and rentals on machinery and equipment for the time actually employed or used on such Extra Work, plus actual transportation charges necessarily incurred if such equipment or machinery be not already on the job together with all power, fuel, lubricants, water, and similar operating expenses; also all necessary incidental expenses, incurred directly on account of such Extra Work, including Social Security, Old Age Benefits, and other payroll taxes, and a ratable proportion of premiums on all Bonds and all insurance as may be required by any law or ordinance, or required by Engineer or Owner, or by them agreed to. Engineer may prescribe the form in which accounts of the “actual field cost” shall be kept and may also specify, in writing, before the Work commences, the method of doing the Work and the type and kind of machinery and equipment to be used, otherwise these matters shall be determined by Contractor. Where practicable, the terms and prices for the use of machinery and equipment shall be incorporated in the Written Work Order or Change Order. The 15 percent of the “actual field cost” to be paid Contractor shall cover and compensate him for his profit, overhead, general superintendence and field office expense, and all other elements of cost and expense not embraced within the “actual field cost” as herein defined, save that where Contractor’s camp or field office must be maintained primarily on account of such Extra Work, then the cost to maintain and operate this office shall be included in the “actual field cost.” When Extra Work is performed by a subcontractor, the 15 percent will apply to the subcontractor only. The Contractor will be allowed 5 percent for overhead and profit.

No Claim for Extra Work of any kind will be allowed unless ordered in writing by Engineer. In case any requirements, response to request for information, response to a submittal or other communication made by Engineer or any other event appear to Contractor to involve Extra Work for which he should receive compensation, Contractor shall immediately, and **in any event within 30 calendar days after being notified of any such requirement, response or communication or after such event**, make written request to Engineer for written authorization there for. Such written request for written authorization shall set forth Contractor's belief of, basis for and amount of expected compensation. IN NO EVENT SHALL CONTRACTOR BEGIN PERFORMING THAT PORTION OF THE WORK AFFECTED BY SUCH REQUIREMENT, RESPONSE, OR COMMUNICATION PRIOR TO GIVING SUCH WRITTEN REQUEST FOR WRITTEN AUTHORIZATION TO THE ENGINEER. Any written request for written authorization not timely made by the Contractor shall be deemed a waiver by the Contractor of its right to assert and recover any additional compensation or otherwise on a Claim in respect of such request, response or communication. Should a difference of opinion arise as to what does or does not constitute Extra Work, or as to the payment therefore, and Engineer insists upon its performance, Contractor shall proceed with the Work after making its written request for written authorization to Engineer and shall keep an accurate account of the "actual field cost" thereof, as provided under Method (C). Engineer shall, within a reasonable time, render and deliver to both Owner and Contractor a written decision on all Claims as provided under Section 6.01 in these General Conditions.

- 7.03. ESTIMATED QUANTITIES. The estimated quantities of the various classes of Work to be done and material to be furnished under this Contract are approximate and are to be used only as a basis for estimating the probable cost of the Work and for comparing the Bids offered for the Work. It is understood and agreed that the actual amount of Work to be done and material to be furnished under this Contract may differ somewhat from these estimates, and that the basis for determining quantities for payment under this Contract shall be the actual amount of such Work done and the material incorporated.

Contractor agrees that he will make no Claim for damages, anticipated profits, or otherwise on account of any differences which may be found between the quantities of Work actually done or the material actually incorporated under this Contract and the estimated quantities contemplated and contained in the Bid.

Where the final quantity of Work performed by Contractor on "Major Unit Price Work" item differs by more than 25 percent from quantity of the item stated in the Contract, a party may request (subject to Owner's approval) an adjustment in the unit price, for the portion that differs by more than 25 percent, by a Change Order. Major Unit Price Work is defined as an individual unit price line item whose original total value i) is greater than five percent of original Contract Price, ii) becomes greater than five percent of original Contract Price as the result of an increase in quantity, or iii) is greater than or equal to \$100,000, whichever is least.

- 7.04. EXTENSION OF TIME. Subject to the remainder of this paragraph, should Contractor be delayed in the completion of the Work by any act or negligence of Owner or Engineer, or by any employee of either, or by other contractors employed by Owner, or by changes ordered in the Work, then, if the other requirements for an extension of time are met, an extension of time shall be allowed for completing the Work sufficient to compensate for the delay, the

amount of the extension to be the amount approved by Owner, based on the recommendation by Engineer; provided, however, that Contractor shall give Engineer notice in writing of the cause of such delay and the impact to the critical path of the schedule prior to the tenth day of the month following the month in which the delay occurred. Failure to file requests for extension of time within the time set forth in and otherwise as required by this paragraph shall constitute a waiver of any rights the Contractor may have had to such extensions of time. Contractor shall support its request for time extension with such information as required by Engineer. Approved extensions of time must be made in writing, signed by the Owner, Engineer, and Contractor.

Contractor will not be allowed time extensions that are due to (i) inclement weather (not including Force Majeure); (ii) non-availability of equipment or material, when the principal units of Work and tasks on the critical path are not in progress or are not delayed by the event of delay, interference, disruption, or hindrance; (iii) when at least seven (7) hours of available working time remain out of the working day; (iv) while materials are drying and it is possible for the Contractor to enclose the area and use drying devices; (v) when an event of delay, interference, disruption, or hindrance occurs on a day other than a working day or other day when the Contractor had not originally planned to work; (vi) when an event of delay, interference, disruption, or hindrance occurs after the expiration of the time for completion; (vii) to the extent the Contractor could have anticipated or alleviated the impact of the event of delay, interference, disruption, or hindrance through reasonable efforts; (viii) when events of concurrent delay overlap the claimed delay; and/or (ix) when an extension of time is precluded by any other provision of the Contract Documents.

- 7.05. HINDRANCES, INTERFERENCES, DISRUPTIONS, AND DELAYS. The Contractor shall receive no financial compensation for delay, interference, disruption, or hindrance at any time in the commencement or progress of the Work for any reason and for any period of time, by an act, omission or neglect, intentional or otherwise, of the Owner, Engineer or any other consultant or Contractor of the Owner, or of an employee of any of them; or by changes ordered in the Work; or by fire, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation; or by other causes that may justify delay. To the fullest extent allowed by applicable Laws and Regulations, in no event shall the Owner be liable to the Contractor or any subcontractor or supplier, any other person or any surety for or any employee or agent of any of them, for any damages arising out of or associated with any delay, interference, disruption, or hindrance to the Work, regardless of the source of the delay, interference, disruption, or hindrance, AND EVEN IF SUCH DELAY, HINDRANCE, DISRUPTION OR INTERFERENCE RESULTS FROM, ARISES OUT OF OR IS DUE, IN WHOLE OR IN PART, TO THE NEGLIGENCE OR OTHER TORTIOUS CONDUCT, BAD FAITH, ARBITRARY OR CAPRICIOUS CONDUCT, INEQUITABLE CONDUCT, BREACH OF CONTRACT OR OTHER FAULT, HOWEVER CHARACTERIZED, OF THE OWNER OR THE ENGINEER OR THE EMPLOYEES, REPRESENTATIVES OR AGENTS OF THE OWNER OR ENGINEER. The Contractor's sole remedy in any such case shall be an extension of time in such amount as allowed by the Section 7.04 of these General Conditions.
- 7.06. FILING CLAIMS. It is agreed that, unless specifically waived in the Contract Documents, all Claims shall be referred to Engineer for a decision. All Claims shall be in writing and filed with Engineer within 30 calendar days of the event giving rise to such Claim, unless a

specific provision of the Contract Documents provide a shorter period of time for such filing, in which case it shall occur within such shorter time. Written notice stating the general nature of each Claim and the amount or extent of the Claim, with supporting data, must be provided as a condition precedent to Contractor's exercise of any rights or remedies he may otherwise have under the Contract Documents. The Claim shall also be accompanied by Contractor's written statement that the adjustment claimed is the entire adjustment to which the Contractor believes he is entitled as a result of said event. Engineer shall reply to such written Claims by Contractor and render his final decision in writing within 30 days of receipt of the Contractor's last submittal. In the event Engineer shall take no action, the Claim shall be deemed denied.

Contractor hereby confirms its willingness and ability to comply with the requirements of the Contract Documents for seeking an adjustment in price or time, damages or other relief and hereby agrees that the time periods, notice requirements and procedures set forth in the Contract Documents are reasonable time periods, notice requirements and procedures and that Owner will be prejudiced if Contractor fails to comply with such time periods, notice requirements and procedures. ACCORDINGLY, CONTRACTOR'S FAILURE TO COMPLY WITH THE TIME PERIODS, NOTICE REQUIREMENTS AND PROCEDURES OF THE CONTRACT DOCUMENTS WITH RESPECT TO A CLAIM FOR ADJUSTMENT IN PRICE OR TIME, DAMAGES OR OTHER RELIEF SHALL CONSTITUTE A WAIVER OF THE CLAIM, INCLUDING CLAIMS ARISING OUT OF OWNER'S NEGLIGENCE, BREACH OF CONTRACT OR OTHER FAULT OR STRICT LIABILITY WITHOUT REGARD TO FAULT.

IT IS FURTHER AGREED THAT ACCEPTANCE BY CONTRACTOR OF THE FINAL PAYMENT SHALL BE A BAR TO ANY CLAIMS OR SUITS BY CONTRACTOR AGAINST OWNER FOR ANY MATTERS RELATED TO THIS CONTRACT, INCLUDING MATTERS ARISING OUT OF OWNER'S NEGLIGENCE, BREACH OF CONTRACT OR OTHER FAULT OR STRICT LIABILITY WITHOUT REGARD TO FAULT.

ARTICLE VIII. TESTS AND INSPECTIONS/ DEFECTIVE WORK/ WARRANTY

- 8.01. TESTING AND INSPECTION. The Owner shall arrange and obtain all inspections and tests required by the Contract Documents; provided, however, that if initial testing fails, all retests will be at Contractor's sole expense. Such testing and inspection is for the sole benefit of Owner, and Owner makes no representation or warranty as to the accuracy of the results of any test or inspection. Contractor at its own expense shall provide such laboratory with all test specimens required by the Contract Documents. The Contractor shall notify the Engineer prior to manufacture or fabrication of items so that observation may be accomplished and furnish field samples of materials to Engineer for testing.
- 8.02. DEFECTS AND THEIR REMEDIES; WARRANTY. It is agreed that if the Work or any part thereof, or any material delivered to the Site for use in the Work or selected for the Work, shall be deemed by Engineer as unsuitable or not in conformity with the Contract Documents, Contractor shall, after receipt of written notice thereof from Engineer, forthwith remove such material and rebuild or otherwise remedy such Work so that it shall be in full accordance with this Contract.

It further is agreed that all Work or any part thereof, including equipment installed, shall be free from defects due to faulty workmanship or materials for period of one year from date of Final Completion, unless otherwise provided in a certificate of Substantial Completion approved by the Owner. Contractor shall notify Engineer in writing 30 days in advance of the expiration of such one-year warranty period, and Engineer shall thereafter schedule a final inspection of the Work prior to the expiration of the warranty period. Contractor's failure to notify the Owner of the expiration of the warranty period, as provided herein, shall extend the warranty period for successive 30 day periods until such written notice is received. Upon notice from Owner, Contractor shall repair defects in all construction that develop during the warranty period, or as noted on the final inspection report, at no cost to Owner. Neither final acceptance nor final payment nor any provision in the Contract Documents relieves Contractor of the above guarantee.

If observed by Owner, notice of the defects will be given by Owner to Contractor with reasonable promptness. Failure to repair or replace defect upon notice entitles Owner to repair or replace same and recover reasonable cost thereof from Contractor and/or his surety.

- 8.03. RIGHT OF ENTRY. Owner reserves the right to enter the property or location on which the Work herein contracted for is to be constructed or installed, by Engineer and such agent or agents as Owner may elect, for the purpose of examining, observing, or testing the Work, or for the purpose of constructing or installing such collateral Work as Owner may desire.

ARTICLE IX. PRICE FOR WORK/ PAYMENTS TO CONTRACTOR

- 9.01. PRICE FOR WORK. In consideration of the furnishing of all the necessary labor, equipment, and material and the completion of all Work by Contractor, and on the Final Completion of all Work and the delivery of all materials embraced in this Contract in full conformity with the Contract Documents, Owner agrees to pay Contractor the final Contract Price. Contractor hereby agrees to pay such prices as are necessary for furnishing all materials and all labor required for the aforesaid Work, including all expenses incurred by him, and for well and truly performing the same and the whole thereof in the manner prescribed by and in accordance with this Contract, including the attached Technical Specifications, and requirements of Engineer.

- 9.02. PROGRESS PAYMENTS. On or before 25th day of each month, the Contractor shall submit an application for progress payment to the Engineer showing the total value of the Work completed. Progress payments for unit price work will be based on the number of units completed. No payment shall be requested nor made for materials purchased or stored on-site that are not yet incorporated into the Work unless specifically authorized by the Owner. If requested, Contractor shall meet with the Engineer at the Site to verify quantity of Work completed.

Beginning with the second application for progress payment, each application shall include an affidavit and lien release 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 with respect to the prior application for payment.

Engineer shall promptly review each application for payment, including required submittals. Engineer shall provide to Owner a statement showing, as complete as practicable and based

upon Engineer's inspections, the total value of the Work completed by the Contractor together with Engineer's recommendation as to payment. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, such payments are not due and payable under the Contract Documents. Payments based on such interim statements are subject to adjustment and correction as set forth in the Contract Documents.

Unless otherwise provided herein, Owner shall pay Contractor the total amount of Engineer's statement, less 10 percent of the amount thereof, and further less all previous payments, and further less all sums that may be retained by Owner under the terms of this Contract. The stated 10 percent retainage may be retained until 30 calendar days after final payment is made. Payment shall be made by Owner on or before the 46th day from receipt of the monthly statement.

Owner may, at Owner's option, withhold part or all of any payment due the Contractor if i) any submittals, reports, Shop Drawings, samples, test reports, or Work progress not be timely or be behind schedule or any requirement of the Contractor as provided in the Contract not be performed or timely or up to date or as scheduled; ii) any Work be defective or not in complete compliance with this Contract or should Contractor otherwise fail to perform Work in accordance with the provisions of this Contract; iii) Owner has incurred damages, including, without limitation, any additional costs associated with design professionals, attorneys or other consultants, as a result of any action or inaction by Contractor not in accordance with the Contract; iv) claims have been made against Owner on account of Contractor's performance or furnishing of the Work; v) Contractor is in breach of the Contract Documents; vi) there is evidence that the Work cannot be completed for the unpaid balance of the Contract Price; vii) Contractor has failed to submit proper statements for payment with all required attachments and supporting documentation; viii) Contractor has failed to make payment to any tier of subcontractor or supplier; and ix) any other items entitling Owner to an offset against the amount recommended for payment. It is understood, however, that in case the whole Work be near completion and some unexpected and unusual delay occurs due to no fault or neglect on the part of the Contractor, the Owner may, at Owner's option and upon written recommendation of the Engineer, pay a reasonable and equitable portion of the retained percentage to the Contractor; or the Contractor, at the Owner's option, may be relieved of the obligation to fully complete the Work and, thereupon, the Contractor shall receive payment of the balance due him under the Contract, subject to the conditions stated in Section 10.01.

Partial payment shall not be construed as an acceptance of defective or non-conforming Work.

- 9.03. PAYMENT OF SUBCONTRACTOR/MATERIAL CLAIMS. Should Owner receive notice of any claim(s) of unpaid labor or materials (or damages) from subcontractors, material suppliers, or any other person or entity, Owner may, at its option, withhold part or all of any payment due the Contractor until Owner, in its discretion, is satisfied that such claim(s) have been fully resolved and paid by Contractor, or Owner may, at its option, pay such claim(s) using the withheld funds.
- 9.04. RIGHT OF SET-OFF. If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract

Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or if the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, or if the Contractor owes the Owner money for any other reason, then, for all purposes and at all times, without waiver or limitation of any of its other rights or remedies under this Contract and applicable Laws and Regulations, Owner shall have the right, but not the obligation, to deduct and withhold the amount of money, if any, that may ever be due from Contractor (or its surety) to Owner from any monies that Owner owes Contractor (or its surety), or to issue a written notice to the Contractor reducing the Contract Price by an amount equal to that which the Owner is entitled.

ARTICLE X. FINAL COMPLETION AND ACCEPTANCE

- 10.01. FINAL COMPLETION, ACCEPTANCE, AND PAYMENT. Upon completion of the Work, Contractor shall give the Engineer written notice that the Work has been fully and finally completed and must certify that the Work is complete and was built in conformance with the Plans, Technical Specifications, and other Contract Documents. Such written notice must be accompanied by all documentation called for in the Contract Documents, including but not limited to (i) the consent of surety to final payment; (ii) Contractor Affidavit for Final Payment and Bills Paid; and (iii) as-built drawings, as described in Section 5.29 of these General Conditions. Drawings will be reviewed by Engineer and returned to Contractor so that any adjustment required may be made.

Contractor shall also furnish like certifications from all subcontractors who performed Work on the Project. Subcontractor certifications shall be limited to that Work actually performed by the subcontractor. Such certifications shall be executed on the forms provided. These certifications must accompany the executed Contractor Affidavit for Final Payment and Bills Paid and are a condition precedent to final payment.

Within 10 calendar days after Engineer receives Contractor's written notice, certification(s), and required documentation, Engineer will schedule inspection by Engineer, Owner, and Regulatory Agencies; provided, however, that additional time shall be allowed for scheduling such inspections if required due to the Regulatory Agencies' availability or responsiveness. If the Work is found to be completed in accordance with the Contract Documents, including the Plans and Technical Specifications, and acceptable to the Engineer, Owner, and Regulatory Agencies, Engineer shall proceed to make final measurements and prepare a final statement of the value of all Work performed and materials furnished under the terms of the Contract Documents and shall submit the final statement to Contractor for approval. Upon receipt from the Contractor of the executed approved final statement and all other documents required by the Contract Documents for final payment, the Engineer shall issue to the Owner a certificate of completion and Contractor-approved final statement of the value of the Work performed. The Owner shall thereafter accept the Work and shall pay to the Contractor on or before the 46th day after the date of the certificate of completion the balance due Contractor under the terms of this Contract, provided he has fully performed his contractual obligations under the terms of this Contract.

The Owner shall be entitled to withhold from such final payment for any circumstance for which Owner is entitled to withhold pursuant to General Conditions. For example, but not by limitation, should Owner receive notice of any claim(s) of unpaid labor or materials (or damages) from subcontractors, material suppliers, or any other person or entity, Owner may,

at its option, withhold part or all of any of the final payments due the Contractor until Owner, in its discretion, is satisfied that such claim(s) have been fully resolved and paid by Contractor, or Owner may, at its option pay for such claims(s) using the withheld funds.

The 10 percent retainage may be held by Owner for 30 calendar days after the date of said payment, after which said retainage will be paid to Contractor in full, provided he has fully performed his contractual obligations under the terms of the Contract and Owner is not otherwise entitled to withhold payment.

It is understood that in the event that all Work has been completed, final payment less 10 percent retainage has been paid, and 30 calendar days have passed but, due to no fault or neglect on the part of Contractor, notification of Regulatory Agency acceptance has not been obtained, then Owner may, at Owner's option, pay Contractor a reasonable and equitable portion of the retainage; or Contractor, at Owner's option, may be relieved of its obligation to further perform hereunder, and thereupon, Contractor shall receive payment of the balance due it under the Contract subject to the conditions stated in this Section.

Neither final acceptance by Owner, nor the final payment, nor any provision in the Contract Documents, shall relieve Contractor of: (i) the obligation for fulfillment of any warranty that may be required in the Contract Documents, including the Technical Specifications; (ii) the obligation to repair defective Work or materials; (iii) Contractor's indemnification obligations under this Contract; or (iv) any of Contractor's continuing obligations.

- 10.02. OPERATION OF FACILITIES. The Owner reserves the right to operate new facilities during the construction period. Use of new facilities by the Owner during construction will not constitute final acceptance of the Work and will not constitute the date for start of any required warranties or guarantees. The Contractor will provide all necessary maintenance, including normal lubrication and adjustment, to new facilities operated by the Owner until final acceptance of the construction.

ARTICLE XI. SUSPENSION OF WORK/ TERMINATION/ DEFAULT

- 11.01. SUSPENSION OF WORK. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than sixty (60) consecutive calendar days by written notice to Contractor.
- 11.02. OWNER'S RIGHT TO CARRY OUT THE WORK. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case the Owner may offset from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Engineer's or other consultant's additional services made necessary by such default, neglect or failure (the "Cost to Cure"). Such action by the Owner and Cost to Cure the Contractor are both subject to prior approval of the Engineer. If payments then or thereafter due the Contractor are less than the Cost to Cure, the Contractor shall pay the difference to the Owner.

11.03. TERMINATION FOR CONVENIENCE OF OWNER. Owner may terminate Contractor's performance under the Contract for Owner's convenience at any time upon written notice to Contractor, whether or not Contractor is in default and, in such event, Owner's only liability will be to pay Contractor the following amounts:

- a. The unpaid balance due Contractor for the Work actually performed and accepted, based on the schedules and tables, unit prices and lump sums enumerated in the Contract Documents; and
- b. Reasonable expenditures made and costs incurred by Contractor for the materials ordered by Contractor for the Work prior to the date of termination and not incorporated in the Work, less reasonable salvage or resale value, provided such materials conform to the Specifications, and for labor performed on any such materials prior to the date of termination and associated labor insurance and labor payroll taxes.

From the total of the items enumerated in items a and b above inclusive, there shall be deducted the total dollar amount of all claims of Owner against Contractor, including the total dollar amount of claims on account of delay or defects in materials and/or workmanship.

The amount payable under the provisions of this section, plus the sum of all amounts previously paid under the Contract, shall in no event exceed the Contract Price.

Contractor shall transfer and assign to Owner in accordance with Owner's instructions, all materials, supplies, Work in process, and other things for which Contractor is entitled to receive reimbursement hereunder, and all plans, drawings, working drawings, sketches, specifications, and information in connection with the Work, and shall take such action as may be necessary to secure to Owner, at Owner's election, the rights of Contractor under any or all orders and subcontracts made in connection with the Work.

If and as Owner so directs or authorizes, Contractor shall sell at a price approved by Owner, or retain at a price mutually agreeable, any such materials, supplies, Work in progress or other things as referred to above. The proceeds of any such sale or the agreed price shall be paid or credited to Owner in such manner as Owner may direct to reduce the amount payable by Owner.

If requested by Owner, Contractor shall endeavor to cancel any or all of its outstanding orders or subcontracts upon such terms as may be approved by Owner.

Upon the performance of the obligations described in this section by the respective parties, all obligations of the respective parties under the Contract shall be discharged, except such obligations as by their terms, express or implied, contemplate continued obligations after acceptance of the Work.

Nothing herein shall affect the right of Owner to terminate Contractor's performance as provided elsewhere in the Contract Documents.

11.04. TERMINATION FOR CAUSE AND EVENTS OF DEFAULT. An event of default includes, without limitation, any one or more of the following:

- a. A petition in bankruptcy is filed by or against Contractor, or Contractor makes a general assignment for the benefit of creditors, or a receiver is appointed on account of the insolvency of Contractor or to take charge of the Work or any part thereof.
- b. Contractor fails or refuses to supply enough properly skilled workers or proper equipment, or fails to make prompt payment when due to subcontractors for materials, equipment or labor.
- c. Contractor disregards the Laws and Regulations or the instructions of Owner or of Engineer.
- d. Contractor breaches any of the provisions of the Contract Documents, or breaches any of its representations or warranties in the Contract Documents, or otherwise fails or refuses to perform or fulfill all or any part of its obligations under the Contract Documents.

If one or more of the identified events occur, Owner or Engineer will provide written notice to Contractor and Contractor's surety of its intent to terminate for cause. Owner will allow a minimum of 5 calendar days to cure deficiencies in performance, then in any such case, Owner may, by written notice to Contractor and its surety, declare Contractor in default under the Contract Documents and terminate Contractor's performance under the Contract and may at its option employ any remedies provided for in the Contract Documents or otherwise available at law or in equity.

Nothing contained herein shall be interpreted as enlarging Owner's legal duty to Contractor or to Contractor's agents, employees, subcontractors, or third parties, or altering the status of Contractor as an independent contractor. Should Owner elect to terminate the performance of Contractor hereunder, then such termination shall not waive, extinguish or diminish the obligations and liabilities of the Contractor or its surety existing as of the termination date. Contractor shall submit and does hereby submit to the personal jurisdiction of the state or federal courts having subject matter jurisdiction and sitting in the county in which the Site is located, for the adjudication of any suit brought to enforce Owner's rights and remedies under the Contract.

- 11.05. REMEDIES FOR DEFAULT OF CONTRACTOR. In the event the Owner elects to terminate Contractor for cause, Owner shall have the right, but not the obligation, at its sole election and discretion, and without prejudice to any other right or remedy available to it, to take possession of the Work and the Site and use all or any part of Contractor's equipment, tools and materials to itself finish, or cause to be finished by another contract, the Work by whatever method Owner may deem expedient. Further, Contractor shall not be entitled to receive further payment until the Work achieves Final Completion. If the unpaid balance of the Contract Price exceeds the costs and expenses of terminating the Contract and finishing the Work, (including, without limitation, attorney's, engineering, surveying and other professionals' fees and costs, together with the costs of completing the Work), such excess shall be paid to Contractor. If such costs and expenses exceed the unpaid balance of the Contract Price, Contractor shall pay the difference to Owner. The amount to be paid to the Contractor or Owner, as applicable, shall be certified by the Engineer, upon application, and this obligation for payment shall survive termination of the Contract.

In the event Owner elects to make demand on Contractor's performance Bond, the Contractor's surety shall be obligated to complete or cause completion of the Work in strict conformity with the Contract, including Contract Times. If the Owner reasonably determines that the surety is not proceeding diligently and with promptness to complete its obligation hereunder, the Owner may provide the surety with written notice of the surety's failure to do so. If seven days after the surety receives said notice, the Owner still reasonably determines that the surety is not proceeding diligently and with promptness to complete its obligation hereunder, Owner may take possession of the Work and the Site and use all or any part of Contractor's equipment and materials to itself finish, or cause to be finished by another contractor, the Work by whatever method Owner may deem expedient as provided in the preceding paragraph.

ARTICLE XII. MISCELLANEOUS

- 12.01. NO THIRD PARTY BENEFICIARIES. The Contract Documents shall not create any rights in third parties and no provision of the Contract Documents shall be construed as creating any obligations for the benefit of, or rights in favor of, any person or entity other than the Owner, the Indemnified Parties, and the Contractor. Without limiting the foregoing, the Owner shall have no obligation to pay or to see to the payment of any monies due to any of Contractor's subcontractors or material suppliers of every tier or to any other person or entity.
- 12.02. SEVERABILITY. Except as provided under Section 5.12 of these General Conditions, if any term, condition or provision of the Contract Documents, or the application thereof to any person or circumstance, shall ever be held to be void, voidable or unenforceable, then in each such event the remainder of the Contract Documents or the application of such term, condition or provision to any other person or any other circumstance (other than those as to which it shall have been held void, voidable or unenforceable) shall not be affected thereby, and each term, condition or provision of the Contract Documents shall remain valid and enforceable to the fullest extent permitted by Laws and Regulations.
- 12.03. NON-WAIVER OF RIGHTS. Any failure by the Owner at any time, or from time to time, to enforce or require the strict keeping and performance of any of the terms or conditions of the Contract Documents shall not constitute a waiver of the right to enforce or require the strict keeping of such terms or conditions and shall not affect or impair such terms or conditions in any way or the right of Owner at any time to avail itself of such remedies as it may have for any subsequent breach or breaches of any such term or condition or of any other term or condition of the Contract Documents, including, without limitation, the right to terminate. Notwithstanding any provision hereof, neither Owner's receipt of non-compliant bonds or non-compliant insurance certificates nor Owner's allowance of Contractor to proceed with the Work, shall be construed to relieve Contractor of its obligation to provide bonds and insurance in favor of Owner according to the requirements of these Contract Documents.

Contractor agrees that Owner shall not be precluded or estopped by any action taken or thing done, written or oral, including, but not limited to, inspections made, payments made, or final completion of the Work, from showing that the true and correct amount and character of the Work done and equipment and materials furnished by Contractor do not in fact conform to the Plans, Technical Specifications or other Contract Documents. Contractor also agrees that Owner shall not be precluded or estopped because of any action taken or not taken, from

demanding and recovering from Contractor any damages resulting therefrom or from the Contractor's other failure to comply with the Contract Documents.

In the event of termination by Owner of Contractor's performance under the Contract for convenience, on account of Force Majeure, or by reason of Contractor's default, no rights or remedies of Owner shall thereby be waived, nor shall any breach by Contractor of the provisions in the Contract Documents which has occurred or is continuing at the time of such termination be waived, regardless of whether or not default has been declared.

- 12.04. OWNER'S AUDIT RIGHTS. Owner's duly authorized representatives shall have access at all reasonable times to all Contractor's and subcontractor's personnel, job description, employment and qualification records, books, records, correspondence, instructions, plans, drawings, receipts, vouchers, data stored in computers, and memoranda of every description pertaining to Work for the purpose of auditing and verifying costs of Work or for any other reasonable purpose. Owner's representatives shall have the right to reproduce any of the aforesaid documents.

Contractor shall preserve and shall cause its subcontractors to preserve all the aforesaid documents for a period of five years after completion and acceptance of termination of Work.

If audit by Owner reveals charges or costs charged to or paid by Owner as costs or fees which are not proper or exceed the rates or amounts permitted under the Contract Documents for any such matters, the Owner shall be entitled upon demand for a refund from Contractor of all such amounts, plus interest thereon from the date of payment by Owner until the date of refund by Contractor at the rate of the lesser of (i) 18 percent per annum or (ii) the maximum rate allowed by law.

- 12.05. NO ASSIGNMENT. Contractor shall not be allowed to assign or otherwise convey all or any portion of this Contract without the express written consent of Owner.
- 12.06. CUMULATIVE RIGHTS AND REMEDIES. The rights and remedies of Owner provided in the Contract Documents shall be cumulative of and not in lieu of all other rights and remedies available to Owner at law or in equity. It is expressly agreed that exercise of a right or pursuit by Owner of any one or more of the remedies provided in the Contract Documents or otherwise available at law or in equity shall not constitute an election of remedies by Owner or forfeiture of any other right of Owner.

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ATTACHMENT A

TEXAS SALES AND USE TAX EXEMPTION CERTIFICATION

Name of purchaser, firm, or agency	
Address (Street & number, P.O. box or route number)	Phone (Area code and number)
City, state, ZIP code	

I, the purchaser named above, claim an exemption from payment of sales and use taxes for the purchase of taxable items described below or on the attached order or invoice form:

Seller: _____

Street address:

City, state, ZIP code:

Description of items to be purchased or on the attached order or invoice:

Purchaser claims this exemption for the following reason:

Texas Tax Code, Section 151.311

I understand that I will be liable for payment of sales or use taxes which may become due for failure to comply with the provisions of the Tax Code: Limited Sales, Excise, and Use Tax Act; Municipal Sales and Use Tax Act; Sales and Use Taxes for Special Purpose Taxing Authorities; County Sales and Use Tax Act; County Health Services Sales and Use Tax; The Texas Health and Safety Code; Special Provisions Relating to Hospital Districts, Emergency Services Districts, and Emergency Services Districts in counties with a population of 125,000 or less.

I understand that it is a criminal offense to give an exemption certificate to the seller for taxable items that I know, at the time of purchase, will be used in a manner other than that expressed in this certificate and, depending on the amount of tax evaded, the offense may range from a Class C misdemeanor to a felony of the second degree.

Purchaser Sign here →	Title	Date
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NOTE: This certificate cannot be issued for the purchase, lease, or rental of a motor vehicle.

THIS CERTIFICATE DOES NOT REQUIRE A NUMBER TO BE VALID.

Technical Specifications

TECHNICAL SPECIFICATIONS

FOR

CYPRESS FOREST PUD – WATER PLANT NO. 2

STORM DAMAGE AND REPAIRS

Prepared for:

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Project No. 4837-PEI



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SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Demolishing and removing existing structures, equipment and materials.
- B. Disposal of demolished materials and equipment.

1.02 MEASUREMENT AND PAYMENT

- A. Unless noted in the Bid sheet, no separate payment will be made for work under this section. Include payment in unit price for applicable work as noted on the bid sheet.

1.03 SUBMITTALS

- A. Submit proposed methods, equipment, materials and sequence of operations for demolition of structures. Describe coordination for shutting off, capping, and removing temporary utilities. Plan operations to minimize temporary disruptions of utilities to existing facilities or adjacent property.
- B. Contractor to prepare and furnish his demolition procedures including the safety procedures to be employed. The safety procedures shall address personnel protection requirements for torch cutting tanks with lead containing paint systems. Project safety is the sole responsibility of the Contractor.

1.04 OWNERSHIP OF MATERIAL AND EQUIPMENT

- A. Materials and equipment designated for reuse or salvage are indicated on the drawings. Protect items designated for reuse or salvage from damage during demolition, handling and storage. Restore damaged items to satisfactory condition.
- B. Materials and equipment not designated for reuse or salvage become the property of the Contractor.
- C. Remove material as work progresses to avoid clutter.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEMOLITION

1.05 STORAGE AND HANDLING

- A. Store and protect materials and equipment designated for reuse until time of installation.

1.06 ENVIRONMENTAL CONTROLS

- A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt and debris.
- B. Use appropriate controls to limit noise from demolition to acceptable levels.
- C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.
- D. Stop demolition and notify Engineer if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.
- E. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Dispose of removed equipment, materials, waste and debris in a manner conforming to applicable laws and regulations.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS FOR DEMOLITION

- A. Fires shall not be permitted.
- B. The use of a "drop hammer" shall not be permitted where the potential for damage to underground utilities exists.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to demolition, make an inspection with Engineer to determine the condition of existing structures and features adjacent to items designated for demolition.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEMOLITION

-
- B. Engineer will mark or list existing equipment to remain the property of the District.

3.02 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions for employees throughout demolition and removal operations. Observe all safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings at all times. Do not obstruct roadways, sidewalks or passageways adjacent to the work.
- C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to District property or adjacent property and facilities.
- D. The Contractor shall be responsible for safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered. Resume demolition only after proper protective measures have been taken.
- E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.03 UTILITY SERVICES

- A. Follow rules and regulations of authorities or utility companies having jurisdiction over water, natural gas, electricity, or telephone services.
- B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

3.04 BUILDING DEMOLITION

- A. Demolish structure to the lines and grades shown on Drawings. Where no limits are shown, the limits shall be 3 feet outside new items to be installed. Removals beyond these limits shall be at the Contractor's expense; satisfactorily reconstruct excess removals.
- B. Proceed with demolition from the top of the structure to the ground. Complete demolition work above each floor or tier before disturbing supporting members of lower levels.
- C. Demolish concrete and masonry in small sections.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEMOLITION

- D. Carefully remove structural framing members and lower them to the ground by means of hoists, derricks or other suitable devices.
- E. Do not overload existing roof or structures.
- F. Provide temporary coverings for openings through walls and roof to prevent water damage to buildings and structures which are to remain.
- G. Where existing concrete must be removed, but will be replaced subsequently:
 - 1. Make initial cut with a concrete saw.
 - 2. After removing concrete, cut cross bars at center of breakout as required for work and protect for subsequent concrete work.
- H. Where openings are cut into existing concrete which will remain open:
 - 1. Make initial cut with saw so as not to damage any reinforcing steel beyond limits of opening.
 - 2. All ends of exposed reinforcing steel to be burned back 1.5 inches below finished surface and then filled with non-shrink grout.
- I. Demolish structures to a minimum of 3 feet below finished grade, unless otherwise indicated on Drawings.

3.05 DISPOSAL

- A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage.
- B. Follow method of disposal as required by regulatory agencies.

3.06 BACKFILL

- A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to density of adjacent soil within 2% of optimum moisture content.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEMOLITION

-
- B. Do not backfill with material from demolition unless approved by Engineer.

3.07 MECHANICAL WORK ITEMS

- A. Mechanical removals consist of dismantling and removing existing piping, equipment and other appurtenances. It includes cutting, capping, and plugging required to restore use of existing utilities.
- B. Remove existing process, water, and other piping not required for new work. Take out piping to the limits shown or to a point where it will not interfere with the new work. Piping not indicated to be removed or which does not interfere with new work shall be removed to the nearest solid support or joint, capped, and the remainder left in place. Flush and purge all piping abandoned in-place with potable water prior to capping or plugging.
- C. When underground piping is to be altered or removed, properly cap the remaining piping. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed. Piping less than 15 inches in diameter may be plugged and abandoned in place unless otherwise noted on plans. Piping 15 inches in diameter and greater to be abandoned shall be filled with sand or flowable grout for longer runs and plugged.
- E. Make any changes to existing plumbing, electrical and heating systems in conformance with applicable codes.
- F. Disinfect and pressure test any portion of the potable water system that has been altered or opened. Perform pressure testing on altered plumbing piping and heating piping.

END OF SECTION

SECTION 02105
EROSION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work to be performed under this item shall pertain to the protection of downstream watercourses (i.e., storm sewer system, ditches, wetlands, etc.) from sediment runoff caused by construction activities. The structures and protection shall be as shown on the plans or as directed by the Owner's Representative at various locations.
- B. Contractor is responsible for implementation of the Pollution Prevention Plan included in the attached exhibits, the requirements of the Texas Pollutant Discharge Elimination System General Permit for Construction Storm Water, and local storm water quality regulations.

1.02 MEASUREMENT AND PAYMENT

- A. Unless noted in the Bidsheet, no separate payment will be made for work under this section. Include payment in unit price for applicable work as noted on the bidsheet.

PART 2 - PRODUCTS

2.01 SAFETY FENCE

- A. Safety fence shall be a minimum of 4 feet in height, orange or yellow in color, and shall have a break load of at least 300 lb/ft and a yield strength of at least 400 lb/ft. Safety fence is to be "Tenax Sentry" or approved equal.

2.02 SAFETY FENCE POST

- A. Safety fence posts are to be Medium Duty No. 1.25, 6-foot metal "Tee" posts.

2.03 FILTER FABRIC FENCE

- A. Filter fabric shall meet the requirements of City of Houston Standard Specification Section 02621- Geotextile.

EROSION CONTROL

2.04 FILTER FABRIC FENCE POSTS

- A. Filter fabric fence posts are to be 2" x 2" wood or equivalent metal with a minimum length of 2' – 6' feet.

2.05 STABILIZED CONSTRUCTION ACCESS

- A. Coarse aggregates shall consist of either crushed stone, gravel, crushed blast furnace slag, or combinations thereof. Aggregate particles shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic or injurious matter.
- B. Coarse aggregates shall conform to the following gradation requirements:

<u>Sieve Size</u> <u>(Square Mesh)</u>	<u>Percent Retained</u> <u>(By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 20
3/4"	60 - 80
No. 4	95 - 100

PART 3 - EXECUTION

3.01 PLACEMENT

- A. Erosion control structures and erosion control protection shall be provided at all storm sewer inlets, at those locations where construction activities are adjacent to wetland and/or drainage ditches, and at other such points as may be designated by the Owner's Representative or shown on the Plans.

3.02 RESPONSIBILITY OF THE CONTRACTOR FOR EROSION CONTROL

- A. The Contractor shall install erosion control measures at the earliest possible time during construction. If the Contractor fails to construct an erosion control structure after having been directed to do so by the Owner's Representative, this shall be cause for stopping construction on all parts of the project if, in the opinion of the Owner's Representative, the conditions warrant such action.

3.03 SAFETY FENCE

- A. Contractor shall install a 4 foot high orange or yellow safety fence at the direction of the Owner's Representative. Fence posts shall be spaced a maximum of 10 feet and are to be bedded 2 feet minimum. The top of the post is to be level with the top of the fence. A 9 gage galvanized wire is to be installed and fastened to the top and bottom of the fence and wire ties shall be used to secure the fence to the posts. Contractor shall be responsible for maintaining this fence.

3.04 FILTER FABRIC FENCE

- A. Contractor shall install filter fabric fences shown on the attached exhibits or at the direction of the Owner's Representative. A trench should be excavated approximately 6 inches wide and 6 inches deep along the line of posts, upslope from the fence. The filter fabric should be stapled or wired to the fence posts with 6 inches of fabric extending into the trench. The fabric should extend a minimum of 15 inches and a maximum of 18 inches above original ground surface.
- B. The filter fabric should be purchased as a continuous roll cut to the length of the fence to avoid the use of joints. When joints are necessary, the fabric should be spliced together only at a support post, with a minimum 6-inch overlap, and sealed securely. When construction is complete, the trench should be backfilled and compacted over the filter material.
- C. The filter fabric fence shall be stapled to the wooden stakes with minimum 1/2" long heavy-duty wire staples. Filter fabric fence shall not be stapled to existing trees.

3.05 STABILIZED CONSTRUCTION ACCESS

- A. Provide stabilized construction access, including truck washing area when authorized by Owner, of the sizes and at locations specified on the Plans.
- B. Wheels must be cleaned prior to exiting the project site to avoid tracking sediment onto public right-of-way. When truck washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilizing area which drains into an earth outlet sediment trap.
- C. Construct stabilized construction access and truck washing area in such a manner as to prevent sediment from entering public right-of-way, storm drain, ditch or

EROSION CONTROL

watercourse through the use of sand bags, gravel, boards, or other similar methods.

- D. The stabilized construction access and truck washing area shall be inspected and maintained daily by the Contractor. Provide top dressing with additional coarse aggregates as required to maintain the minimum berm depth. Repair and cleanout damaged measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way must be removed immediately.

3.06 VEGETATIVE BUFFER STRIPS

- A. All existing vegetation within areas designated on the plans as "vegetative buffer strips" shall be preserved in its natural condition. Areas shall not be disturbed by construction equipment traffic, materials storage, parking of worker's vehicles, or other construction related activities.

3.07 SOD

- A. When directed by the Owner or noted in the Bid Proposal, Saint Augustine sod (16 inch wide single row, 32 inch double row) will be placed behind the back of curb after placement of the pavement.
- B. Sod strips shall be watered to promote a healthy growth. Portions of sod strips which fail to thrive shall be replaced at the Contractor's expense.

3.08 BURLAP SAND BAGS

- A. After placement of pavement, inlet protection devices (burlap sand bags) will be placed on either side and the back of Stage II storm inlets as shown on the plans.
- B. Sand bags shall be removed upon final acceptance by the Owner, or when the Owner's Representative so directs.

3.09 INLET PROTECTION BARRIER

- A. The entire perimeter of unfinished storm sewer inlets (Stage 1) will be protected with reinforced filter fabric and board covers as shown on the plans.
- B. Inlet protection barriers shall be removed prior to construction of Stage II of the storm sewer inlets.
- C. Sand bags will be placed in gutters on each side of existing inlets at locations shown

on the plans.

3.10 MAINTENANCE

- A. Contractor shall inspect all structural controls within 24 hours after any storm event that meets or exceeds 0.5 inches of rainfall in a 24-hour period. During prolonged rainfall events, Contractor shall inspect structural controls on a daily basis. At a minimum, structural controls should be inspected once every 14 calendar days. A qualified representative of the Contractor, as approved by the Owner, shall provide these inspections. Should controls become ineffective, necessary repairs shall be performed to return the integrity of the structural controls.
- B. Sediment deposits shall be removed and spread evenly on surrounding ground upslope from the fence when deposits reach approximately 1/3 the height of the filter fabric fence.

PART 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

If included in the Bid Sheets, the following items will be measured as described:

- A. Filter fabric fence will be measured by the linear feet of completed and accepted filter fabric fence between the limits of the beginning and ending wooden stakes.
- B. Stabilized construction access, and truck washing area if provided, will be measured by the square yard of aggregate placed in 8-inch layer and including the beginning and ending tapered sections.
- C. Sod will be measured by the linear foot of curb protected (single or double row as indicated on the bid sheet).
- D. Stage I inlet protection barriers will be measured by each inlet protected.
- E. Stage II inlet protection barriers will be measured by each inlet protected.
- F. Sand bags will be measured per each sand bag placed in the gutter.

EROSION CONTROL

4.02 PAYMENT

- A. Payment for filter fabric fence shall be at the fixed bid price for total required fabric fencing. Bid unit price shall include all labor, equipment and materials.
- B. Payment for stabilized construction access or truck washing area shall be for the total bid price of total square yard requirements. Bid price shall include all labor, equipment and materials.
- C. Payment for sod shall be at a fixed bid price for total linear foot of curb protection required, (single or double row as required). Bid price shall include all labor, equipment and materials.
- D. Payment for Stage I inlet protection barriers shall be at a fixed bid price per total inlets required. Bid price shall include all labor, equipment and materials.
- E. Payment for Stage II inlet protection barriers shall be at a fixed bid price per total inlets required. Bid price shall include reinforced filter fabric fence surrounding Stage I inlet, all labor, equipment, and materials.
- F. Payment for the maintenance, permitting, inspections, and reporting of Pollution Prevention Implementation shall be at the bid unit price as indicated on the bid sheet. Bid price shall also include all pollution prevention measures from prior contracts as shown on the plans.

END OF SECTION

SECTION 02235

WASTE MATERIAL DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Waste material disposal consists of the following:
 - 1. Disposal of trees, stumps, logs, brush, roots, grass, vegetation, humus, rubbish and other objectionable matter from operations such as clearing and grubbing, excavation and grading.
 - 2. Disposal of unsuitable material or excess material from roadway excavation, road side-ditch excavation, open cut excavation, tunnel excavation, site construction and ditch excavation.
 - 3. Disposal of material from work specified in the Plans or Specifications as removal and disposal.
- B. This section shall not apply to the disposal of contaminated material, which shall be disposed of by legally approved methods at approved off-site locations, at bid price.

1.02 MEASUREMENT AND PAYMENT

- A. Unless noted in the Bid sheet, no separate payment will be made for work under this section. Include payment in unit price for applicable work as noted on the plans and bid sheet.

1.03 SUBMITTALS

- A. If excess soil is deposited on private property, the Contractor must secure written permission from the property Owner to do so prior to doing so. Coordinate thru Engineer. Any deposited excess soil not preapproved will be removed at cost of Contractor, and at no cost to Owner, within 60 days from date of removal notice from property Owner or Owners Representative, after which time the Owner may elect to remove at a cost that is to be paid by Contractor.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.01 DISPOSAL AREA

- A. Waste material must be removed from the work site and disposed of at an approved location in a manner not to damage the Owner or other persons.
 - 1. The Contractor shall not dispose of any excavated materials within an area designated as being within the 100-Year Flood Hazard Area. It shall be the Contractor's responsibility to verify the flood plain status of any proposed disposal site.
 - 2. If excess soil is deposited on any private or public property, the Contractor must secure written permission from the property Owner to do so. Written permission must include a legal description of the property on which the soil is deposited and a description of exact location and existing conditions on that property. Provide before and after photos of exact location for Owners and Engineers review. Provide copy for Engineers review before presenting to property Owner.
 - 3. Contractor shall adhere to any written conditions imposed by Owner or Engineer when depositing on property.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS SERVICE ENTRANCE

SECTION 02552

NATURAL GAS SERVICE ENTRANCE

PART 1 GENERAL

1.01 SUMMARY

- A. Natural Gas Utility Charges: Natural Gas Utility charges for extension of distribution system to point of service termination and meters will be paid by Owner, except where bid allowance is indicated, or where specifically noted otherwise on plans or in other specifications.
- B. Temporary service disconnects at existing installations shall be paid for by Contractor. Prompt reconnection of service shall be coordinated by Contractor. All temporary disconnection and reconnection costs are to be paid for by Contractor.
- C. Refer to Section 16013 – “Electrical Submittals” for submittal requirements.

1.02 DEFINITIONS

- A. Natural Gas Utility: Local Gas Company.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA): NFPA No. 70 - National Electrical Code (NEC).
- B. Gas Company Standards:
 - 1. Installation shall strictly comply with current Gas Company Standards. Where plans conflict with Gas Company standards, contact Engineer for directions before starting work. Failure to do so is at Contractor’s risk.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS SERVICE ENTRANCE

PART 2 PRODUCTS

2.01 GAS SERVICE

A. Gas Service Characteristics:

1. As indicated on Drawings and provided by Gas Utility.

B. Gas Meter Location: Locate gas based on drawing from Gas Company. Do not install Gas equipment without this data statement and without confirming location with Gas Company and Engineer. Contact Engineer prior to construction. Provide submittal with layout of Gas Company's line, Owner's Gas line and generator for review by Engineer and Gas Company before starting construction. Send copy of Gas Company "Service Confirmation and Drawings" to Engineer for review. Any construction performed without Engineer's review is at Contractor's risk and expense.

PART 3 EXECUTION

3.01 PREPARATION

A. Confirmation of Gas Service:

1. Consult with Gas Utility to verify service information specified and shown on Drawings. Failure to do so may result in removal and replacement of service equipment at Contractor's cost. Do not start service installation work until "Service Confirmation" has been received from Gas Company and has been reviewed and approved in writing by the Engineer.
2. Include deviations required by Gas Utility from contract documents to comply with Gas Utility standards and requirements. Send drawing of final service arrangement for engineer's review. Do not install service equipment until approved by Gas Company in writing.
3. Relocate service meter and structure up to (20) twenty feet to maintain clearance required by Gas Utility Company or to maintain other clearances. Coordinate exact point of service with Gas Company and locate customer service Gas line within distance of Gas Company line as per Gas Company Standards. Failure to coordinate location is at expense of Contractor and at no additional cost.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS SERVICE ENTRANCE

B. Metering:

1. Consult with Gas Utility regarding service entrance requirements and metering equipment. Conform strictly to Utility Company standards.
2. Install metering equipment to meet standards and requirements of Gas Utility.

C. Application for Gas Service.

1. Obtain required forms from Gas Utility.
2. Assist Owner in completion of forms and deliver completed forms to Gas Utility. Advise Owner of exact requirements.
3. Coordinate schedule for installation of electric service with Electric Utility.
4. Notify utility company in writing, within 30 days of project start date that permanent service will be required for this project. Specify date required and location of project.
5. Notify Engineer, in writing of date service applied for, date to be installed, Gas Company contact name and telephone number and copy of “Service Confirmation” as this information become available. Do not start construction of service without this report and without confirming service location with Engineer.
6. Contractor is responsible to see that service is connected according to the Gas Company standards. Final permanent service connection by Gas Company is required before project is considered complete, before final acceptance, and before final payment is made.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS DISTRIBUTION FOR GENERATORS

SECTION 02554

NATURAL GAS DISTRIBUTION FOR GENERATORS

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and apply to this Section.

1.02 SUMMARY

- A. This Section includes piping, valves, and specialties for natural gas distribution outside the building.
- B. This Section does not include final connection to utility's natural gas main.

1.03 DEFINITIONS

- A. Gas Main: Utility's natural gas piping.
- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Point of Delivery: Piping outlet from service-meter assembly.
- D. Natural Gas Piping: Piping that conveys natural gas from point of delivery to natural gas utilization devices inside building.
- E. PE: Polyethylene plastic.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Ratings: According to the following:
 - 1. Service Regulators: 65 psig
 - 2. Service Meters: 65 psig

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS DISTRIBUTION FOR GENERATORS

1.05 SUBMITTALS

- A. Product Data: Include identification materials and devices; and pressure ratings, rated capacities, and settings for the following:
 - 1. Service components. Include valves, regulators, and specialty fittings.
 - 2. Piping specialties.
- B. Shop Drawings: Include pipe sizes, valves, regulators, gas meters, and specialties. Include details of service-meter assembly and underground piping. Indicate interface and spatial relationship between piping, adjacent utilities, and proximate structures.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Test Reports: As specified in "Field Quality Control" Article.
- E. Maintenance Data: For service regulators, service meters, and specialty valves to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Distribution Components: Listing/approval stamp, label, or other marking by testing agency acceptable to authorities having jurisdiction.
- B. Comply with requirements of utility supplying natural gas.
- C. Comply with standards of authorities having jurisdiction for natural gas piping systems. Include materials, installation, and testing.
- D. Comply with NFPA 54, "National Fuel Gas Code," for gas piping materials and components; installations; and inspection, testing, and purging.
- E. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS DISTRIBUTION FOR GENERATORS

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle liquids to avoid spillage and ignition. Notify gas supplier. Do not leave flammable liquids on premises overnight.
- B. Preparation for Transport: Prepare valves and specialties for shipping as follows:
 - 1. Ensure that units are dry and internally protected against rust and corrosion.
 - 2. Protect against damage to threaded ends, flange faces, and weld ends.
 - 3. Set valves in position for handling that avoids damage to seats and operating parts.
- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent damage and entrance of dirt, debris, and moisture.
- D. Store valves and specialties with end protectors in place, unless necessary for inspection; then reinstall for storage.
- E. Store valves and specialties indoors and maintain temperature higher than ambient dew-point temperature. Support off ground or pavement in watertight enclosures if outdoor storage is necessary.
- F. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor if stored inside.
- G. Protect flanges, fittings, and piping specialties from moisture and dirt.
- H. Store plastic pipes and valves protected from direct sunlight. Support pipes to prevent sagging and bending.

1.08 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner & Engineer of Record not less than two days in advance of proposed utility interruptions.

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2. Do not proceed with utility interruptions without Owner's written permission.

1.09 COORDINATION

- A. Coordinate connection to gas main and meter assembly with utility.
- B. Coordinate pipe materials, sizes, entry locations, and pressure requirements with natural gas piping.
- C. Coordinate with other utility Work.
- D. Work Interruptions: Leave natural gas distribution piping in safe condition if interruptions in Work occur while alterations or repairs are being made to existing gas piping.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Lubricated, Tapered Plug Valves:
 - a. Grinnell Corp.; Mueller Co.; Gas Products Div.
 - b. National Meter.
 - c. Nordstrom Valves, Inc.
 2. Ball Valves:
 - a. Nibco, Inc.
 - b. Stockham Valves & Fittings, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 3. Lubricated Plug Valves:
 - a. Huber: J.M. Huber Corp.; Flow Control Div.

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- b. Olson Technologies, Inc.; Homestead Valve Div.
 - c. Walworth Co.
 - 4. Service Regulators:
 - a. American Meter Co.
 - b. Fisher Controls International, Inc.
 - c. National Meter
 - 5. Service-Meter, Bypass Fittings:
 - a. Lyall: R.W. Lyall & Co., Inc.
 - b. Williamson: T.D. Williamson, Inc.
 - 2.02 PIPING MATERIALS
 - A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
 - 2.03 PIPES
 - A. Steel Pipe: ASTM A 53, Type E or S, Grade B; Schedule 40, black.
 - 2.04 PIPE FITTINGS
 - A. Malleable-Iron Fittings: ASME B16.3, Class 150, standard pattern, with threads complying with ASME B1.20.1.
 - B. Unions: ASME B16.39, Class 150, black malleable iron; female pattern; brass-to-iron seat; ground joint.
 - C. Steel Fittings: ASME B16.9, wrought-steel butt-welding type; and ASME B16.11, forged steel.
 - D. Steel Flanges and Flanged Fittings: ASME B16.5.
 - E. Transition Fittings: Type, material, and with end connections matching piping being joined.
 - 2.05 JOINING MATERIALS

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- A. Components, Tapes, Gaskets, and Bolts and Nuts: Suitable for natural gas and as recommended by piping manufacturer.

2.06 SHUTOFF VALVES

- A. Description: Manual-operation valves suitable for natural gas service and with 100-psig minimum working-pressure rating.
 - 1. Threaded Valves, 1-Inch NPS and Smaller: Include listing by agency acceptable to authorities having jurisdiction.
- B. Lubricated, Tapered Plug Valves: Cast-iron body, with lubricated, brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842, or AGA/IAS listing. Include lever.
 - 1. Option: Include locking device.
- C. Ball Valves: Bronze body, with chrome-plated brass ball; lever handle; and complying with ASME B16.33, MSS SP-110, UL 842, or AGA/IAS listing.
 - 1. Option: Include locking device.
- D. Lubricated Plug Valves: Cast-iron body, with lubricated, tapered, or cylindrical plug; lever operation; and complying with ASME B16.38, MSS SP-78, UL 842, or AGA/IAS listing.
 - 1. Option: Include locking device.
- E. Valve Boxes: Cast-iron, two-section box. Include top section with cover with "GAS" lettering, bottom section with base to fit over valve and barrel 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and stem of length required to operate valve.

2.07 SERVICE REGULATORS

- A. Description: AGA/IAS-listed for service regulators, single stage, steel jacketed, and corrosion resistant. Include atmospheric vent, elevation compensator, with threaded ends for 2-inch NPS and smaller, and flanged ends for 2-1/2-inch NPS and larger.
- B. Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening.

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2.08 PIPING SPECIALTIES

- A. Strainers: Y-pattern, full size of connecting piping. Include ASTM A 666, Type 304 stainless-steel screens with 3/64-inch perforations, unless otherwise indicated.
 - 1. Pressure Rating: 125-psig minimum steam or 175-psig WOG working pressure.
 - 2. 2-Inch NPS and Smaller: Bronze body, with female threaded ends.
 - 3. 2-1/2-Inch NPS and Larger: Cast-iron body, with flanged ends.
 - 4. Screwed screen retainer with centered blow-down and pipe plug.

2.09 CONCRETE BASES (WHERE SHOWN ON PLANS)

- A. Concrete Bases: Precast, reinforced, made of 3000-psi- minimum, 28-day compressive strength concrete; and 4 inches thick and 4 inches larger in dimension than supported item, unless otherwise indicated.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in specifications.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off gas to premises or piping section.
- B. Inspect natural gas piping according to NFPA 54 to determine that natural gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54, Part 1, "Prevention of Accidental Ignition" Paragraph.

3.03 PIPING APPLICATIONS

- A. Flanges, unions, transition and special fittings, and valves with pressure ratings same or higher than system pressure rating may be used, unless otherwise indicated.

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B. Aboveground Piping: Use the following:

1. 2-Inch NPS and Smaller: Steel pipe, butt-welding-type fittings, and welded joints. Joints for connection to threaded service regulators, service meters, and valves may be threaded.
2. 2-Inch NPS and Smaller: Steel pipe, malleable-iron fittings, and threaded joints.
3. 2-1/2-Inch NPS and Larger: Steel pipe, butt-welding-type fittings, and welded joints. Joints for connection to service regulators, service meters, and valves with flanged connections may be flanged. Joints for connection to service regulators, service meters, and valves with threaded connections 2-1/2- to 4-inch NPS may be threaded.

C. Underground Piping:

1. Black steel piping of sizes indicated for above ground piping.
2. Piping shall be black steel of sizes and fittings as indicated for above ground piping and be either tar coated with paper wrap or covered with City of Houston approved factory wrapped film.

3.04 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. If specific valve types are not indicated, the following requirements apply:

1. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping gas mains.
2. Underground: Do not use valves, install valves about ground only.
3. Above ground, 2-Inch NPS and Smaller: Lubricated, tapered plug valves.
4. Above ground, 2-Inch NPS and Smaller: Ball valves.
5. Above ground, 2-1/2-Inch NPS and Larger: Lubricated plug valves.

3.05 JOINT CONSTRUCTION

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- A. Refer to specifications for basic piping joint construction.
 - B. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
 - C. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3.06 PIPING INSTALLATION

- A. Install buried gas distribution piping at least 24 inches deep, unless shown otherwise on Plans. Provide red, 12 inch wide marker tape 12 inches above line
- B. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum length nipple of three pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- C. Install strainers on inset side of service regulators and valves.
- D. Terminate vent piping with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

3.07 VALVE INSTALLATION

- A. Install shutoff valves on branch connections to underground gas distribution piping. Install valves with valve boxes.
- B. Install metal shutoff valves on aboveground, gas distribution piping.
- C. Install aboveground, metal shutoff valves in accessible locations, protected from physical damage. Include metal tag indicating piping systems supplied, attached to valve with metal chain.

3.08 SERVICE-METER ASSEMBLY INSTALLATIONS

- A. Install service-meter assemblies aboveground. Provide precast concrete bases where shown on Plans.

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- B. Installation of service meters is by Gas Company. Contractor shall coordinate and verify meter assembly will provide required gas pressure and volume rate (CFH).
 - C. Install pressure-relief or pressure-limiting devices so they can be readily operated to determine if device is free, tested to determine pressure at which they will operate, and examined for leakage if closed.
 - D. Terminate service-regulator vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

3.09 CONNECTIONS

- A. Connect gas distribution piping to natural gas source and extend to service-meter assemblies and points indicated. Terminate piping with caps, plugs, or flanges, as required for piping material. Connect to emergency generator as required.
- B. Connect to utility gas main according to utility's procedures and requirements.
- C. Connect to existing gas distribution main according to ASME B31.8.

3.10 ELECTRICAL BONDING AND GROUNDING

- A. Install aboveground, natural gas distribution piping upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
- B. Do not use gas piping as grounding electrode.

3.11 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, meter, and earthquake valve.
 - 1. Text: Distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.
- B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape during backfilling of trenches for piping.
- C. Refer to specifications for warning tapes.

3.12 PAINTING

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- A. Refer to specifications for field-painting requirements.
 - B. Use materials and procedures in specifications. Include gray color, unless otherwise indicated.
 - C. Paint exposed metal pipe, fittings, valves, and supports.
 - D. Paint exposed metal regulators, meters, and supports, except units with factory-applied paint or protective coating. Restore damaged finish to original condition.

3.13 FIELD QUALITY CONTROL

- A. Inspect, test, and purge natural gas distribution according to NFPA 54, Part 4, "Inspection, Testing, and Purging," and utility requirements.
- B. Repair leaks and defects with new materials and retest system until there are no leaks.
- C. Report test results in writing to Architect and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of service regulators, meters, and valves.
- E. Verify correct pressure settings for service regulators.

3.14 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.

1.01 REFERENCES

- A. American Concrete Institute (ACI):

1. 117-90 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. 211.1-91 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
3. 214-77 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
4. 302 1R-89 - Guide for Concrete Floor and Slab Construction.
5. 304 R-89 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
6. 305R-91 - Hot Weather Concreting.
7. 306R-88 - Cold Weather Concreting.
8. 308-92 - Standard Practice for Curing Concrete.
9. 318-92 - Building Code Requirements for Reinforced Concrete.
10. 347R-88 - Guide to Formwork for Concrete.

- B. American Society for Testing and Materials (ASTM):

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1. C31-91 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. C33-92 - Standard Specification for Concrete Aggregates.
3. C39-86 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. C94-92 - Standard Specification for Ready-Mixed Concrete.
5. C143 REV A-90 - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. C150-92 - Standard Specification for Portland Cement.
7. C156-91 - Standard Test Method for Water Retention by Concrete Curing Materials.
8. C 172-90 - Standard Practice for Sampling Freshly Mixed Concrete.
9. C231 REV B-91 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
10. C260-86 - Standard Specification for Air-Entraining Admixtures for Concrete.
11. C309-91 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
12. C494-92 - Standard Specification for Chemical Admixtures for Concrete.
13. C618 REV B-92 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as Mineral Admixture in Portland Cement Concrete.
14. C845-90 - Standard Specification for Expansive Hydraulic Cement.
15. C881-90 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
16. C1017-92 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

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17. C1059-91 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
18. C 1116-91 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
19. D1751-83 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
20. D1752-84 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

C. U.S. Army Corps of Engineers (CRD):

1. C513-74 - Specification for Rubber Waterstops.
2. C572-74 - Specification for Polyvinyl Chloride Waterstop.

D. Federal Specifications (FS):

1. UU-B-790A - Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent, and Fire Resistant).

E. National Ready Mixed Concrete Association (NRMCA).

1.02 SYSTEM DESCRIPTION

A. Tolerances:

1. Conform to requirements of ACI 117.
2. Concrete slabs shall be within 3/16 in. of 10-ft straightedge in all directions except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 in.
3. Floor tolerances shall be by F-number system.
 - a. Slabs on grade and formed slabs without camber.

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	Overall	Local
Troweled Finish	F _F 25 F _L 20	F _F 18 F _L 14
Float Finish	F _F 18 F _L 15	F _F 13 F _L 10

- b. The F-number not applicable to sloped surfaces and cambered surfaces.
 - c. Deviation from elevation shall not exceed 3/4 in.
4. Pitch floor to floor drains minimum of 1/8 in. /ft or as shown on Drawings. Minimum thickness of slabs and depth of beams shall be as dimensioned on Drawings. Pitch bottom of slab or beam to match top slope of slab or beam to maintain thickness or depth noted. As an alternate, bottom of slab or beam may be poured level provided that minimum thickness or depth is maintained.

1.03 SUBMITTALS

A. Shop Drawings:

- 1. Construction Joints: Sequence of placing concrete and location and details of joints, openings, and embedded items not shown on Drawings. Coordinate sequence of placement and joint location with reinforcement Shop Drawings. Submit with reinforcement submittals required in Section 03200.
- 2. Control Joints in Slabs on Grade: Location and details of joints.
- 3. Verification of Mix Design:
 - a. Proposed mix design for each class of concrete to be used as specified using designations indicated. Provide dry weight of cement, saturated surface dry weight of coarse and fine aggregates, brand name and quantity of admixtures when applicable, fly ash when applicable, gallons of water required for 1 cu yd of concrete, and chloride ion content.
 - b. Test data supporting proportions of design mixes (excluding Class AA) based on laboratory trial batches in accordance with ACI 318, Chapter 5.

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- c. As alternative to test data based on laboratory trial batches, test data supporting proportions of design mixes based on past field experience in accordance with ACI 318, Chapter 5 may be submitted. If this data, in Engineer's opinion, is not in accordance with ACI 318, Engineer will require submittal of test data based on trial batches.
- d. Submit with admixture product data and miscellaneous submittals required herein.
- e. Mix design shall be approved by Engineer before concrete delivered to site.

B. Product Data:

- 1. Waterstop: Samples of material, splicing details, and manufacturer's literature indicating conformance with these Specifications.
- 2. Curing Compound, Sealers, and Hardener: Proposed rate of coverage and manufacturer's literature indicating conformance with these Specifications.
- 3. Concrete Admixtures:
 - a. Manufacturer's literature.
 - b. Submit with mix design.
- 4. High Range Water Reducers:
 - a. Name of product and manufacturer's literature.
 - b. Intended use area.
 - c. Name of manufacturer's on-site representative.
 - d. Submit with mix design.
- 5. Miscellaneous Materials:

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- a. Non-slip Aggregate manufacturer's literature.
 - b. Finishing Grout manufacturer's literature.
 - c. Bonding Compound manufacturer's literature.
 - d. Control Joint manufacturer's literature.
 - e. Epoxy Joint Filler manufacturer's literature.
 - f. Form Liners manufacturer's literature.
- C. Test Results:
- 1. Concrete test results.
 - 2. With each load of concrete delivered, provide duplicate delivery tickets, one for Contractor and one for Engineer, with following information.
 - a. Date and serial number of ticket.
 - b. Name of ready mixed concrete plant, operator, and job location.
 - c. Type of cement, admixtures, if any, and brand name.
 - d. Cement content, in bags/cu yd of concrete, and mix design.
 - e. Truck number, time loaded, and name of dispatcher.
 - f. Amount of concrete in load, cu yds, delivered.
 - g. Maximum size aggregate.
 - h. Gallons of water added at job, if any, and slump of concrete after water was added.
 - i. Temperature of concrete at delivery.
 - j. Time unloaded.
- D. Miscellaneous Submittals:
- 1. NRMCA certification or certificate stating plant and equipment complies with

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NRMCA requirements specified herein.

2. Statement by ready mix supplier giving source and material certificates of cement and fine and coarse aggregates, including sieve analysis, that will be used in manufacture of each class of concrete. Make no changes in sources of materials.
 3. Fly Ash: Source and test reports showing fly ash in compliance with these Specifications. Reports shall be for actual fly ash to be used in Work.
 4. Method of pumping concrete.
 5. Submit with mix design.
- E. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

- A. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, non-agitating units, and ticketing system.
- B. Concrete Testing: Testing shall be provided by Owner in accordance with Section 01455 and this section.
1. Conduct tests on sample material in accordance with applicable ASTM methods listed below.
 - a. Slump: ASTM C143.
 - b. Air-Entrainment: ASTM C23 1.
 - c. Compressive Strength Test: ASTM C31 (making and cylinders curing) and ASTM C39 (testing).
- C. Approval of use of high range water reducer and non-chloride accelerator contingent, in part, on assurances manufacturer's representative will be on-site for at least first 2 days of use and materials used within manufacturer's recommended dosage range.

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1.05 PROJECT/SITE CONDITIONS

A. Hot Weather:

1. Comply with ACI 305R.
2. Concrete temperature shall not exceed 90°F.
3. At air temperatures of 80°F or above, keep concrete as cool as possible during placement and curing.
4. When concrete temperatures exceed 80°F, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.

B. Cold Weather:

1. Comply with ACI 306R.
2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35°F. Preheat if temperature below 35°F.
3. Maintain air and forms in contact with concrete sections having minimum dimension less than 12 in. at temperature above 50°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.
4. Maintain air and forms in contact with concrete in more massive sections at temperature above 40°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement:

1. ASTM C150.
2. Non-hydraulic Structures: Type I or II except tri-calcium aluminate (C₃A) content of Type I shall not exceed 12%.
3. Hydraulic Structures: Type I or II except tri-calcium aluminate (C₃A) content of Type I shall not exceed 8%. If this type of Type I not available, Type I with C₃A

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content less than 12% shall be used in combination with fly ash.

4. Type III may be substituted for Type I when approved by Engineer and additional requirements for Type I stated above are met.
5. Where shrinkage-compensating concrete required, cement shall conform to ASTM C845, Type E- 1(k).
6. When aggregates determined to be deleteriously reactive, as defined by Appendix XI of ASTM C33, alkali content of cement defined by Table 1A of ASTM C150 shall not exceed 0.60%.

B. Fly Ash:

1. ASTM C618, Class C or F including requirements of Table 1A.
2. Supplemental Requirements:
 - a. Loss on Ignition (maximum): 3%.
 - b. Water Requirement (maximum): 100% (as percent of control).
 - c. Fineness (maximum retained on No. 325 sieve): 25%.
 - d. $\frac{\text{CaO (\%)} - 5}{\text{Fe}_2\text{O}_3 (\%)}$ (R-factor) (maximum): 1.5.

C. Aggregates:

1. ASTM C33 modified as follows.
 - a. Fine Aggregate: Natural sand.
 - b. Coarse Aggregate: Crushed gravel, crushed stone or gravel, Size 467 (1-1/2 in. maximum), Size 67 (3/4 in. maximum), Size 8 (3/8 in. maximum).
2. Potential reactivity of aggregates shall be determined in accordance with Appendix XI of ASTM C33.

D. Admixtures for Concrete:

1. Air-Entraining: ASTM C260.

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2. Chemical Admixtures: Optional, ASTM C494, non-corrosive and chloride free.
3. Chemical Admixtures for Flowing Concrete, ASTM C1017:
 - a. Type 1, Water reducing, high range.
 - b. Type 2, Water reducing and retarding, high range.
- E. Water: Potable.
- F. Pre-molded Joint Filler:
 1. ASTM D1751.
 2. ASTM D1752, Type I, II or III.
 3. Closed cell polyethylene.
- G. Waterstops:
 1. Virgin polyvinyl chloride (PVC) waterstop conforming to CRD C572.
 2. Rubber waterstop conforming to CRD C513.
 3. Construction and Contraction Joints: Rubber or PVC, dumbbell or serrated type, 6 in. wide by 3/8 in. thick, at center. If 4-in. wide waterstop indicated on Drawings, it shall be 3/16 in. thick at center.
 4. Expansion Joints: Rubber, dumbbell type, 9 in. wide by 3/8 in. thick at center, with 3/4 in. inside dia hollow center bulb.
 5. Use gasket type waterstop only where noted on Drawings. Waterstop shall be glued and nailed to substrate.
 6. Provide prefabricated tees, crosses, and other configurations as required. Splice in accordance with manufacturer's written instructions.
- H. Non-stip Aggregate:
 1. Manufacturers:

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- a. Grip-It by L&M Construction Chemicals, Inc.
 - b. Frictex NS by Sonnebom.
 - c. Non-Slip Aggregate by Euclid Chemical Company.
 - d. Emery NS by Dayton Superior.
 - e. Or equal.
 - 2. Minimum 50% aluminum oxide content.
- I. Clear Floor Hardener:
- 1. Manufacturers:
 - a. Flouhard by L&M Construction Chemicals, Inc.
 - b. Saniseal by Master Builders Company.
 - c. Lapidolith by Sonnebom.
 - d. Day-Chem Hardener J- 15 by Dayton Superior.
 - e. Penalith by W.R. Meadows.
 - f. Fluosilicate by Symons.
 - g. Or equal.
 - 2. Colorless, aqueous solution of zinc or magnesium fluosilicate.
 - 3. Each gal of fluosilicate solution shall contain not less than 2 lbs of crystals.
- J. Floor Sealer:
- 1. Manufacturers:
 - a. Sikagard Cure/Hard by Sika Corporation.
 - b. Kure-N-Seal by Sonnebom.
 - c. Cure and Seal by Symons.

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- d. Dress and Seal 18 by L&M Construction Materials, Inc.
 - e. Tuf-Seal J-35 by Dayton Superior.
 - g. Or equal.
- K. Membrane Forming Curing Compound:
 - 1. Manufacturers:
 - a. Dress and Seal 30 by L&M Construction Materials, Inc.
 - b. Super Pilo-Cure by Euclid Chemical Company.
 - c. Master Kure by Master Builders.
 - d. Kure-N-Seal 30 by Sonnebom.
 - e. Or equal.
 - 2. ASTM C309, and compatible with scheduled finishes and coatings, except permeability shall not exceed 0.39 kg/m²/72 hrs.
- L. Finishing Grout:
 - 1. Manufacturers:
 - a. Thoroseal with Acryl 60 by Thoro.
 - b. Concrete Finisher with AKKRO-7T by Tamms Industries Company.
 - c. Or equal.
- M. Cement Grout: Mixture of cement and fine sand in proportions used in concrete being finished.
- N. Epoxy Bonding Compound:
 - 1. Manufacturers:
 - a. Sikadur Hi-Mod by Sika Corporation.

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- b. Epoxitite 2362 by A.C. Hom.
 - c. Euco Epoxy 452 MV or 620 by Euclid Chemical Company.
 - d. Fresh Concrete Binder R649 by Rescon.
 - e. Resi-Bond J-58 by Dayton Superior.
 - f. Epobond by L&M Construction Materials, Inc.
 - g. Or equal.
- 2. Use when joining new to existing concrete.
- 3. Conforming to ASTM C881.
- O. Non-Epoxy Bonding Compound:
 - 1. Manufacturers:
 - a. Weld-Crete, by Larsen Products Corporation.
 - b. Acryl 60 by Thoro.
 - c. Acrylset by Master Builders.
 - d. Everbond by L&M Construction Materials, Inc.
 - e. Or equal.
 - 2. Use when joining new to existing concrete where bonding compound cannot be placed immediately prior to pouring of new concrete.
 - 3. Conforming to ASTM C1059 Type II.
- P. Preformed Control Joint Strips:
 - 1. Manufacturers:
 - a. Kold-Seal Zip-Per Strip by Kold-Seal Vinytex Corporation.
 - b. Stresslock by H. Compton Company.

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- c. Quick Strip by Schlegel Corporation.
 - d. Or equal.
 - 2. Plastic joint former with locking tabs.
 - 3. Depth: 1/4 of slab thickness.
- Q. Epoxy Joint Filler:
- 1. Manufacturers:
 - a. Euco Epoxy 600 or 700 by Euclid Chemical Company.
 - b. Sikadur 51 by Sika Corporation.
 - c. MM80 by Metzger/McGuire.
 - d. Flexresin R8 IO or Flexresin Paste R811 by Symons.
 - e. Epoflex of Everjoint by L&M Construction Materials, Inc.
 - f. Poxo-Fil J-52 by Dayton Superior.
 - g. Or equal.
 - 2. Minimum Shore Hardness of 70.
- R. Evaporation Retardant:
- 1. Manufacturers:
 - a. Econ by L&M Construction Materials, Inc.
 - b. Confilm by Master Builders.
 - c. Eucobar by Euclid Chemical Company.
 - d. Or equal.
- S. Fiber Reinforcement:

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1. Manufacturers:
 - a. W.R. Grace & Co.
 - b. Fiberresh Company.
 - c. Euclid Chemical Company.
 - d. Or equal.
2. 1/2-in. to 3/4-in. collated fibrillated virgin polypropylene fibers.
3. ASTM C1116 Type III.
4. Underwriters Laboratories rated.

2.02 CONCRETE MIX DESIGN

- A. Concrete Mix: Measure and combine cements, aggregates, water, and admixtures in accordance with ASTM C94 and ACI 211.1.

1. Cement: When used in exposed concrete shall be one brand from one source. Do not mix different cements in same element or portion of Work.
2. Water-Cement Ratio: 0.45 maximum. If fly ash is used, water-cement plus fly ash ratio 0.45 maximum.
3. Air-Entrainment: Air-entrain concrete exposed to freezing or liquid containment.
4. Chemical Admixtures: Use is optional to aid concrete properties and allow for efficient placement. Manner of use and amount shall be in accordance with manufacturer's written recommendations and as approved by Engineer. Do not use admixtures which increase early shrinkage or negatively affect finishing.
5. Fly Ash: Use is optional unless otherwise noted. Combine fly ash with cement at rate of 1.5 lbs fly ash/lb reduction in cement. Amount of fly ash shall not be less than 15% nor more than 25% of weight of cement plus fly ash. When fly ash is used, minimum amount of cement given in table for Class of Concrete may be proportionately reduced.
6. Use no admixture other than specified, unless approved by Engineer.

- B. Class of Concrete:

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1. Furnish in accordance with table. Cement contents listed are minimum values and shall be increased as required to attain other specified characteristics.
2. Air contents listed are for concrete requiring air-entrainment as specified herein. If high range water reducing admixture is used, contents listed shall be maintained after addition of admixture.
3. Slumps listed are maximum, except when high range-water reducer is used. Maximum slump when high range water reducer is used, 10 in.
4. Chloride ion content shall not exceed values listed in ACI 318, Table 4.3. 1.

Class I	Compressive Strength (psi)	Coarse Aggregate size No.)	Minimum Cement Factor (bags/cu yd)	Air Content (%)	Slump (in.)
AA	4,000	None	8.0	8 ∇ 2	6 maximum
A1	4,000	467	5.5	52 ∇ 1	3 ∇ 1
A2	4,000	67	6.0	6 ∇ 1	3 ∇ 1
B1	3,000	467	4.5	52 ∇ 1	3 ∇ 1
B2	3,000	67	4.75	6 ∇ 1	3 ∇ 1
B3	3,000	8	5.0	7 ∇ 1	4 maximum
C	4,000	467	6.0	6 ∇ 12	3 ∇ 1
F	2,000	67	2.25	-----	-----

C. Concrete Usage:

1. As indicated in drawings.

2.03 MODIFICATION OF MIX DESIGN

- A. After sufficient test data available from Project, provisions of ACI 214 may be used to reduce amount by which average strength must exceed specified 28-day compressive strength provided.

1. Probable frequency of strength tests more than 500 psi below specified 28-day

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compressive strength will not exceed 1 in 100.

2. Probable frequency of average of 3 consecutive strength tests below specified 28-day compressive strength will not exceed 1 in 100.

- B. Do not reduce cement content below minimum amount specified except as allowed in combination with fly ash.
- C. Submit verification of mix design as described in Part 1 of this section.

2.04 MIXING AND DELIVERY

- A. Use ready mixed concrete.
- B. Deliver and complete discharge within 1-1/2 hrs of commencing of mixing or before 300 revolutions of drum or blades, whichever comes first. Includes revolutions required by transit mix trucks. Limitations may be waived by Engineer if concrete slump, after 1 2 hrs or 300-revolution limit reached, that concrete can be placed without addition of water. In hot weather, time or number of revolutions criteria may be reduced by Engineer.
- C. Do not add water on-site unless slump and water-cement ratio, after addition of water, are below maximum allowed. If water added, mix concrete at site additional 30 revolutions of drum.
- D. Deliver concrete to site having temperature not less than 50°F nor greater than 90°F.
- E. If high range water-reducing admixture added on-site, mix concrete at site additional 85 revolutions of drum after addition of high range water-reducing admixture.

2.05 MASS CONCRETE

- A. Definition: Concrete sections of 4 feet or more in the least dimension.
- B. Do not use high early-strength cement (Type III) or accelerating admixtures.
- C. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.
- D. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit revibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

PART 3 EXECUTION

3.01 FORMS

- A. Formwork design, detailing, and installation shall be Contractor's responsibility and shall conform to requirements of ACI 347R.
- B. Materials and Construction: Type of forms used is Contractor's option, except as otherwise indicated below or on Drawings. Plywood and other wood surfaces shall have smooth, level surfaces treated with form oil or sealer to produce clean release of concrete from forms.
 - 1. Where walls remain exposed use plywood, prefabricated metal or wood forms. Do not use boards.
 - 2. Use bolts, rods or other approved devices for form ties. Plastic cone snap ties are approved as form ties. Ties for liquid holding structures or dry structures below grade shall have integral waterstop. Do not use wire ties on exposed concrete.
 - 3. Ties shall be removed minimum of 1 in. from formed surface. Removal of ties shall leave holes clean cut and without appreciable spalling at face of concrete. Provide plastic cone or other approved device.
 - 4. Provide 3/4 in. chamfer on external corners of exposed concrete walls, beams, columns, equipment bases and exposed edges of construction joints. Do not chamfer columns flush with concrete block walls.
 - 5. Provide openings at base of vertical forms as access for cleaning and inspection of forms and reinforcing prior to depositing concrete.
- C. Treat or Wet Contact Forms: Coat plywood and wood moldings with non-staining form release agent. Apply release agent before reinforcement is placed.
- D. Repairing and Cleaning: Clean, patch, and repair form material before reusing.
- E. Workmanship:
 - 1. Formwork shall prevent leakage of mortar, shall not deflect under weight of concrete and workman, and shall withstand fluid pressures of concrete.

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2. Removal of wall ties shall leave holes clean cut and without appreciable spalling at face of concrete.

3.02 PATTERNED CONCRETE

- A. Install and remove form liners in accordance with manufacturer's recommendations.
- B. Form liners shall be covered and protected as recommended by manufacturer when not in use.
- C. Rustication strips shall be used at all joints and edges of panels. Butt joints between panels are not allowed.
- D. Position form liner against formwork so edges, pattern, and joints are square.
- E. Seal joints and edges to prevent grout leakage.
- F. Plan for inwork so ties are located at rustications, grooves, or other areas to minimize visual effect. Tie dia and location shall be coordinated with rib width and location, and approved by form liner manufacturer.
- G. Clear cover for reinforcement shall be 2 in. Care shall be taken to provide adequate clear cover at all points of liner.
- H. Pour shall never be stopped part way up liner.
- I. Dress joints and edges to match pattern features.

3.03 SUBGRADE PREPARATION

- A. Sub-grade and bedding shall be compacted and free of frost. If placement allowed at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.
- B. Provide seal slabs where noted, where necessary, and when required by Engineer to obtain dry and stable working platform for placement of slabs on grade. Mud slabs shall be 3 in. thick minimum. Provide vapor barrier between seal slabs and sub-grade.
- C. Provide vapor barrier between sub-grade and slabs where noted on Drawings, overlap joints minimum of 6 in.

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D. Where vapor barrier not noted, at Contractor's option, provide vapor barrier or soak sub-grade evening before placement and sprinkle ahead of placement of concrete.

E. Remove standing water, ice, mud, and foreign matter before concrete deposited.

3.04 PLACING CONCRETE

A. Notify Engineer 24 hrs in advance of placing operation.

B. Place concrete, except as modified herein, in accordance with ACI 304R, Chapter V.

C. Concrete will not be allowed to drop freely where reinforcing will cause segregation of mix.

1. Superplasticized Concrete: 10-ft maximum drop.

2. Other Concrete: 5-ft maximum drop.

D. If pumping to be used, do not use aluminum piping for delivery system.

E. When placing of concrete temporarily halted or delayed, provide construction joints as shown on Drawings and as specified.

F. Place in lifts not exceeding 24 in. and compact with internal mechanical vibrator equipment.

1. Insert vibrator so area visibly affected by vibrator overlaps adjacent just-vibrated area by a few inches.

2. Beams shall be vibrated separately before slab placement. Place slab concrete after vibrating beam, but before beam concrete reaches initial set.

3. Slabs: Insert vibrators for full depth of slab. Allow vibrator to penetrate slab into previously placed beams.

4. Walls: Insert vibrators along each face (i.e., just behind reinforcing) and allow vibrator to sink into previous lifts as deep as will easily penetrate.

5. Along Waterstop: Insert vibrators along full length of waterstop alternating on each side at 12-in. maximum centers.

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- 6. Do not spread concrete with vibrators.
- G. Minimum of 2 hrs shall elapse after depositing concrete in columns and walls before depositing concrete in adjoining beams, girders or slabs, unless otherwise approved by Engineer.
- H. If in process of pouring wall, pour is stopped unexpectedly, leave surface of joint level but rough. Roughened surface shall have amplitude of 1/4-in. minimum. Before depositing new concrete against hardened concrete, retighten forms and place 2-in. layer of Class AA concrete. Provide water-stop in locations as specified herein.
- I. Provide bonding compound between new and hardened or existing concrete where shown on Drawings.
- J. When hot and/or wind conditions will result in evaporation of 0.2 lb/sf/hr or more, evaporation retardant shall be used in accordance with manufacturer's recommendations to minimize plastic shrinkage cracking.

3.05 JOINTS

- A. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer. Locate to miss splices in reinforcement. Provide waterstops in locations shown on drawings and specified herein.
- B. Limit size of concrete pours. Follow method and pattern of joint placement as shown in the drawings.
- C. Before concrete placed, construction joints shall be cleaned and laitance removed and surface wetted. Remove standing water.
- D. Locate construction joints in floors within middle third of span. Construction joints in floors supported by walls may be located at center of wall with Engineer's approval.
- E. Construction joints in beams shall be offset minimum distance of 2 times width of intersecting beams.
- F. Locate vertical construction joints in walls minimum of one-half wall height from corners or other intersecting walls or at midpoint between corners or intersecting walls. Locate horizontal joints in walls within middle third of wall height.
- G. Beams shall be placed monolithically as part of slab system, unless otherwise indicated on Drawings.

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- H. Construction joints shall have keys or roughened surfaces. Use keys where shown on drawings. Use roughened surface elsewhere. Where roughened surface used, surface shall have amplitude of 1/4 in. minimum.
- I. Make control joints in slabs on grade of preformed control joint strips set flush with finished surface, by construction joint, by tooled joint, or cut 1/4 in. wide joints with diamond saw within 12 hrs after pouring.
 - 1. Cut alternate reinforcing bars or wires crossing joint.
 - 2. Provide preformed control joint strip in full length un-spliced pieces unless special splice designed to prevent misalignment of splice joint.
 - 3. Control joints shall be 1/4 depth of slab, unless shown otherwise on Drawings.
 - 4. Fill construction joint, tooled joint and sawed control joints with epoxy joint filler.
 - 5. Space joints as shown on Drawings.
- J. Install pre-molded joint filler where noted in accordance with manufacturer's recommendations. Joint filler shall be compatible with sealant and suitable for intended purpose.
- K. Clean and prime joints in accordance with manufacturer's written instructions before applying sealant.

3.06 WATERSTOPS

- A. Provide waterstop in construction joints in:
 - 1. Locations shown on drawings.
 - 2. Walls and slabs separating liquid from earth or air.
- B. Installation: Secure in-place. Place wire tie holes, if used, within 1 in. of edge.
- C. Splice joints in waterstop to form continuous watertight diaphragm. Splice in accordance with manufacturer's recommendations. Spark test joints as required by Engineer.

3.07 EMBEDDED ITEMS

- A. Cast pipe and other embedded items into concrete as placement progresses. Do not

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provide blackouts unless specifically noted on Drawings.

- B. Following restrictions shall be adhered to, except for slabs on grade, unless otherwise noted.
 - 1. No duct, conduit, pipe or fitting placed vertically shall be larger in cross-sectional area than 4% of column into which it is placed.
 - 2. Duct, conduit, pipe, and fittings, when placed within slab and walls, shall not be larger than 1/3 thickness of slab or wall nor placed closer than 3 outside dia clear from each other.
 - 3. Reinforcing steel shall be in-place before embedded items placed and reinforcing cut or removed shall be replaced with additional reinforcing as indicated on Drawings or approved by Engineer.
 - 4. Do not pass sleeves through columns without Engineer's approval.
- C. Do not place ducts, conduits, and pipes in slabs on grade. Place minimum 4 in. under bottom of slab.
- D. Set items such as bolts, anchors, piping, and frames in concrete as shown on Drawings.
- E. Set miscellaneous items according to templates and setting diagrams.
- F. Place items constructed of dissimilar metals to avoid physical contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during pouring. Contact between reinforcing and other metal, other than bare, coated or plated carbon steel not permitted, unless approved by Engineer.
- G. Support wall pipes from formwork to prevent contact with reinforcing.

3.08 REPAIR OF SURFACE DEFECTS

- A. General:
 - 1. Prior to starting repair work, except as specified otherwise, obtain Engineer's approval of proposed repair techniques and mixes.

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2. Develop patching techniques and mixes on portion of as-cast surface selected by Engineer for this purpose. Dress surface of patches remaining exposed to view to match color and texture of adjacent surfaces.

B. Tie Holes:

1. Fill tie holes, except where sealant is indicated, with patching mortar as specified in Section 03605.

C. Defective Areas:

1. Remove honeycombing, stone pockets, spalls, and other defective concrete down to sound concrete. If chipping required, make edges perpendicular to surface. Do not feather edges.
2. Fill defective area with patching mortar as specified in Section 03605.

D. Blockouts at Pipes or Other Penetrations:

1. Fill with non-shrink grout.
2. Match appearance to adjacent concrete on exposed surfaces.
3. Conform to details shown.

E. Leaks or Wet Spots:

1. Patch and repair areas where leaks or wet spots have occurred in structures.
2. Repair method shall be Contractor's, subject to requirements of these Specifications and review by Engineer.

3.09 FINISHING SLABS AND FLATWORK

A. Stab Finishes:

Description	Concrete Finish
Depressed Setting Beds for Ceramic Tile	Float
Surfaces to Receive Grout or Topping	Float
Submerged Slabs	Float

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Depressed Areas for Floor Mats	1 Throweling
Floor Coverings (Carpet, Resilient Tile, Quarry Tile, and Sewnless Granular Epoxy)	1 Throweling
Sealer Applied Floors and Slabs	3 Trowelings
Exterior Exposed Slabs	Float and Broom Finish
Exterior Stairs, Ramps, Walks	Float and Broom Finish
Interior Stairs and Ramps (where concrete has no subsequent finish)	1 Troweling and Broom Finish

- B. After placement, screed concrete with straightedges, power strike-offs or vibrating screeds.
- C. After screeding, bull float or darby surface to eliminate ridges and to fill in voids left by screeding.
- D. Float:
 - 1. Use magnesium or aluminum hand floats or power floats with slip on float shoes after concrete has stiffened to point where 1/4 in. maximum indentation can be imparted by normal foot pressure. Do not use combination blades for floating.
 - 2. Float finish shall result in uniform smooth granular texture.
 - 3. After floating, check slab tolerances with 10-ft straightedge. Fill low spots with fresh concrete.
 - 4. Do not sprinkle with dry cement or add water.
- E. Trowel:
 - 1. Use steel trowels after floating.
 - 2. Initial Troweling: Power or hand with trowel blade kept flat against concrete surface to prevent washboard or chatter effect.
 - 3. Second Troweling: By power if 3 trowelings scheduled, by hand if 2 trowelings scheduled.
 - 4. Third Troweling: By hand and continue until concrete consolidated to uniform, smooth, dense surface free of trowel marks and irregularities.

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5. Successively trowel with trowels progressively smaller and tipped more to increase compaction of concrete surface.
 6. Allow time between trowelings for concrete to become harder.
 - F. Broom Finish: Use fine, soft-bristled broom and broom at right angles to direction of traffic to give nonskid finish. Texture shall be approved by Engineer.
 - G. Heavy Broom Finish: Use steel wire or stiff coarse fiber broom and broom at right angles to direction of traffic while concrete is still soft enough to produce deep scouring. Texture shall be approved by Engineer.
 - H. Non-slip Finish: Apply where shown on room finish schedule. Trowel concrete to hard finish with non-slip aggregate added in accordance with manufacturer's written instructions. After finishing, broom or score exterior work.
 1. Clear Floor Hardener: Apply according to manufacturer's written instructions where shown on room finish schedule.
 - J. Floor Sealer:
 1. Apply in accordance with manufacturer's written instructions.
 2. Apply first coat after final troweling, surface water glaze has dissipated, and when surface is hard enough to sustain foot traffic on same day as pour.
 3. When floor has been water cured, apply first coat after curing has been completed. Apply within one day of floor being dry enough for application.
 4. Apply second coat after Work complete and building ready for occupancy.
 - K. For special coatings or finishes, see room finish schedule on Drawings.
- 3.10 FINISHING FORMED CONCRETE
- A. Ordinary Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water or sewage or subsequent construction.
 1. Patch honeycombing, stone pockets, form ties, spalls, and other irregularities as

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specified in this section and cure.

2. Where joint marks or fins on submerged surfaces exceed 1/4 in., grind smooth.
- B. Smooth Finish: Interior concrete surfaces permanently exposed to view, interior surface of tanks exposed to view extending 6-in. below liquid level, and concrete surfaces scheduled to be painted.
1. After removal of forms, patch or point up defects as specified and cure.
 2. Grind joint marks and fins smooth with adjacent surface. Remove oil stains and rinse surface.
 3. After grinding and cleaning, dampen concrete and paint entire surface with Cement Grout. Work Cement Grout into surface with cork or other suitable float. When grout has set to where it will not be pulled out of holes or depressions, brush off surface with dry burlap or carpet.
 4. Prepare surfaces to be painted in accordance with Section 09961 and paint manufacturer's requirements.
- C. Rubbed Finish: Exterior cast-in-place concrete surfaces permanently exposed to view extending to 6 in. below finish grade or liquid level, unless otherwise and where indicated on Drawings.
1. After removal of forms, patch or point up defects as specified and cure.
 2. Remove joint marks, fins, and stains as described for smooth finish.
 3. Apply heavy coat of Finishing Grout. After first coat has set, apply second coat. When second coat has set, float to uniform texture.
 4. Follow manufacturer's written instructions for finishing concrete.
 5. Finish color shall be gray.
- D. Sandblast Finish: Bridge columns and bewns.
1. Provide a medium sandblasted finish.
 2. Provide a test patch 4 ft-0 in. by 4 ft-0 in. in size illustrating surface finish and texture for Engineer approval.

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3. Provide necessary tarps or plastic sheets to protect adjacent surfaces against damage and to control dust created by sandblasting operations.
4. Exposure depth shall be sufficient to remove form marks and provide uniform texture of exposed surfaces.
5. Approximate maximum depth from form face shall be as per approved sample.
6. Sandblasting shall be by experienced operators using power machinery designed for this use. Engineer may require adequate proof, to his satisfaction, of competence of workmen and equipment.
7. Sandblasting materials shall be silica sand, crushed quartz, granite, or white um sand of Type A or B (A preferred) and of a hardness of approximately 6 on MOHS scale.
8. Provide safety valves to prevent over-pressure in storage tanks, receivers, or other parts of equipment.
9. Sandblast by "flash" method, passing continuously over surfaces to provide a uniform cutting of surface without pitting aggregate. Exercise care to prevent comers or sharp edges of concrete work from being broken or unduly rounded.
10. Comply with all requirements of local governing agency relating to sandblasting or application of any kind of abrasive treatment to buildings or structures.

3.11 PROTECTION AND CURING

- A. Protect concrete from frost and keep moist for minimum curing period of 7 days after placing in accordance with ACI 308.
- B. Formed Surfaces:
 1. Wet cure by spraying surfaces during curing period as frequently as drying conditions may require to keep concrete surfaces moist.
 2. Ceilings, walls, columns, and beam sides may be cured by leaving forms in-place. For vertical surfaces, apply water to run down on inside of forms, if necessary, to keep concrete wet.

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3. After forms are removed, wet cure for remainder of curing period or apply curing compound.
4. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other coatings or adhesives will be applied.

C. Concrete Flatwork:

1. Start curing activities as soon as free water has disappeared from surface of concrete after placing and finishing.
2. Cure flatwork using liquid curing compound or wet cure.
3. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other coatings or adhesives will be applied.
4. Cure bottom slab of water containing structures by ponding water on slab.

D. Curing Compound:

1. Apply curing compound at uniform rate sufficient to comply with requirements for water retention as specified and as measured in accordance with ASTM C156.
2. Cover areas subjected to direct sunlight during curing period with ambient temperature expected to exceed 80°F with white pigmented compound; others may be covered with fugitive dye compound.

E. Protect from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

F. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and rain or running water.

G. Do not load self-supporting structures to overstress concrete.

3.12 REMOVAL OF FORMING AND SHORING

- A. Do not remove forming or shoring until member supported has acquired sufficient strength to safely support own weight and any imposed loads. Forming shall remain in place for at least minimal time recommended by ACI 347R. In addition, forming for horizontal members such as elevated slabs and bawns shall remain in place minimum of 7

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days. In no case shall forming for horizontal members be removed before concrete has reached at least 70% of its specified design strength.

- B. Re-shore areas as required to carry additional imposed loads.
- C. Repair damage to structure caused by early removal of forming and shoring at no additional cost to Owner.

3.13 FIELD QUALITY CONTROL

- A. Obtain samples of concrete in accordance with ASTM C172. Transport cylinders to place on-site where they can be stored under conditions affecting concrete they represent without being disturbed for first 24 hrs.
- B. Make slump tests daily and when requested by Engineer, in accordance with ASTM C143. Make slump tests from same batch from which strength tests are made.
- C. When air-entrained concrete used, make air content tests daily and when requested by Engineer in accordance with ASTM C231.
- D. If measured slump or air content falls outside limits specified, make check test immediately on another portion of same sample. In event of second failure, concrete shall be considered to have failed to meet requirements of Specifications and will be rejected.
- E. Strength test for each class of concrete consists of 4 cured standard cylinders made from composite samples secured from single load of concrete in accordance with ASTM C172. Make compressive strength tests on 1 cylinder at 7 days and 2 cylinders at 28 days. Test results at 28 days shall be average strength of 2 specimens as determined in accordance with ASTM C39, except if one (1) specimen in test shows manifest evidence of improper sampling, molding or testing, it will be disregarded. Test remaining cylinder if needed.
- F. Make strength test for each following condition for each class of concrete.
 - 1. Each day's pour.
 - 2. Each change of source.
 - 3. Each 100 cu yds of concrete poured.

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4. When temperatures are below or expected to fall below 45°F within 48 hrs after concrete placed, make 2 additional cylinders and cure in field under conditions approximating conditions affecting concrete they represent. Test one at 7 days, other at 28 days.
- G. Strength level of individual class of concrete considered satisfactory if following requirements met.
1. Average of all sets of 3 consecutive strength tests equal or exceed specified 28-day compressive strength.
 2. No individual strength test falls below specified 28-day compressive strength by more than 500 psi.
- H. If analysis of strength tests indicates above requirements are not being met, make immediate adjustments to mix. Also, if likelihood of low strength concrete is confirmed, make additional tests as required by Engineer to determine strength of concrete in-place in portion of structure identified with deficient cylinders. If tests and analysis verify Work in-place is not in conformance with Specifications, Engineer will determine whether or not Work in-place is adequate for intended use in location. If Work is determined inadequate, Contractor shall follow such remedial or replacement measures which Engineer may require.

Contractor shall bear costs in connection with testing, engineering analyses, remedial work, and replacement required under terms of this paragraph.

END OF SECTION

SECTION 03350
CONCRETE FINISHING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Repairing surface defects.
- B. Finishing concrete surfaces including both formed and unformed surfaces.
- C. Sealing concrete surfaces.
- D. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners.

1.02 UNIT PRICES

- A. Unless noted in the Bid sheet, no separate payment will be made for work under this section. Include payment in total price for applicable work as noted on the Bid sheet.

1.03 REFERENCES

- A. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
- B. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- D. ASTM D 4587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.
- E. ASTM E 1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F Number System.

1.04 SUBMITTALS

- A. Submit manufacturer's technical literature on the following products proposed for use. Include manufacturer's installation and application instructions and, where specified, manufacturer's certification of conformance to requirements and suitability for use in the applications indicated.
 - 1. Floor hardener.
 - 2. Sealer.
 - 3. Epoxy floor topping.
 - 4. Epoxy penetrating sealer.
 - 5. Latex bonding agent.
 - 6. Abrasive aggregate.
 - 7. Evaporation retardant.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Sealer/Dustproofer (VOC Compliant): Water-based acrylic sealer; non-yellowing under ultraviolet light after 200-hour test in accordance with ASTM D 4587. Conform to local, state and federal solvent emission requirements.
- B. Epoxy Floor Topping: Two-component epoxy resin meeting ASTM C 881 Type III, resistant to wear, staining and chemical attack, blended with granite, sand, trap rock or quartz aggregate, trowel-applied over concrete floor. Topping thickness, 1/8 inch; color, gray.
- C. Abrasive Aggregate for Nonslip Finish: Fused aluminum oxide grit, or crushed emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Material shall be factory graded, packaged, rustproof and nonglazing, and unaffected by freezing, moisture and cleaning materials.

- D. Epoxy Penetrating Sealer: Low-viscosity, two-component epoxy system designed to give maximum penetration into concrete surfaces. Sealer shall completely seal concrete surfaces from penetration of water, oil and chemicals; prevent dusting and deterioration of concrete surfaces caused by heavy traffic; and be capable of adhering to floor surfaces subject to hydrostatic pressure from below. Color, transparent amber or gray; surface, nonslip.
- E. Latex Bonding Agent: Non-redispersable latex base liquid conforming to ASTM C 1059. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.
- F. Bonding Grout: Prepare bonding grout by mixing approximately one-part cement to one part fine sand meeting ASTM C 144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At Contractor's option, a commercially-prepared bonding agent used in accordance with manufacturer's recommendations and instructions may be used. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required. Submit manufacturer's technical information on proposed bonding agent.
- G. Patching Mortar:
 - 1. Make patching mortar of same materials and of approximately same proportions as concrete, except omit coarse aggregate. Substitute white Portland cement for part of gray Portland cement on exposed concrete in order to match color of surrounding concrete. Determine color by making trial patch. Use minimum amount of mixing water required for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with trowel until it has reached stiffest consistency that will permit placing. Do not add water.
 - 2. Proprietary compounds for adhesion or specially formulated cementitious repair mortars may be used in lieu of or in addition to foregoing patching materials provided that properties of bond and compressive strength meet or exceed the foregoing and color of surrounding concrete can be matched where required. Use such compounds according to manufacturer's recommendations. When used in water and wastewater treatment structures, material shall be suitable for use under continuously submerged conditions. Conformance and

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suitability certification by manufacturer is required.

- H. Epoxy Adhesive: Two-component, 100 percent solids, 100 percent reactive compound developing 100 percent of strength of concrete, suitable for use on dry or damp surfaces. Epoxy used to inject cracks and as a binder in epoxy mortar shall meet ASTM C 881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C 881, Type V.
- I. Non-shrink Grout: See Section 03600 - Grout.
- J. Spray-Applied Coating: Acceptable products are Thoro System Products "Thorseal Plaster Mix" or equal. Color: Gray.
- K. Concrete Topping: Class H concrete with 3/8-inch maximum coarse aggregate size, as specified in Section 03310 - Structural Concrete.
- L. Concrete Fill: Class H concrete with 3/8-inch maximum coarse aggregate size, (Class C where fill thickness exceeds 3 inches throughout a placement), as specified in Section 03310 – Structural Concrete.
- M. Evaporation Retardant: Confilm, manufactured by Master Builders; Eucobar, manufactured by Euclid Chemical Company; or equal.

PART 3 – EXECUTION

3.01 AGGREGATE CONCEALMENT

- A. Unless indicated otherwise on Drawings or approved by Owner's Representative, all surfaces to be finished shall be free of exposed aggregate.

3.02 REPAIRING SURFACE DEFECTS

- A. Defective Areas: Repair immediately after removal of forms. Remove honeycombed and other defective concrete down to sound concrete but in no case to a depth less than one inch. Make edges of cuts perpendicular to concrete surface. Thoroughly work bonding grout into the surface with a brush as that the entire surface is covered. Alternatively, a proprietary bonding agent may be used. Use bonding agent in accordance with manufacturer's instructions. While bonding coat is still tacky, apply premixed patching mortar. Thoroughly consolidate mortar into place and strike off to

leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hour before final finishing. Keep patched area damp for 7 days. Alternatively, a proprietary cementitious repair mortar may be used and placed in accordance with manufacturer's instructions. Do not use metal tools in finishing patches in formed walls which will be exposed.

- B. Tie Holes: Patch holes immediately after removal of forms. After cleaning and roughening with a wire brush on a rotary drill, thoroughly dampen tie hole and fill solid with patching mortar. Taper tie holes shall have the plug, specified in Section 03100 – Concrete Formwork, driven into the hole to the center of the wall before grouting. Completely fill taper tie holes with patching mortar except that non-shrink grout shall be used for all walls in contact with soil or liquid. On wall faces exposed to view, fill the outer 2 inches of the taper tie hole with patching mortar blended to match adjacent concrete.
- C. Cracks: Repair cracks in excess of 0.01 inch by pressure injection of moisture-insensitive epoxy-resin system. Submit proposed material and method of repair for approval prior to making repairs.
- D. Structural Repair: When required, make structural repairs after prior approval of Owner's Representative as to method and procedure, using specified epoxy adhesive or approved epoxy mortar.

3.03 FINISHING OF FORMED SURFACES

- A. Unfinished Surfaces: Finish is not required on surfaces concealed from view in completed structure by earth, ceilings or similar cover, unless indicated otherwise on Drawings.
- B. Rough Form Finish:
 - 1. No form facing material is required on rough form finish surfaces.
 - 2. Patch tie holes and defects. Chip off fins exceeding 1/4 inch in height.
 - 3. Rough form finish may be used on concrete surfaces which will be concealed from view by earth in completed structure, except concealed surfaces required to have smooth form finish, as shown on Drawings.
- C. Smooth Form Finish:

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1. Form facing shall produce smooth, hard, uniform texture on concrete. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
2. Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave smooth, unmarred finished surface.
3. Provide smooth form finish on the wet face of formed surfaces of water-holding structures, and of other formed surfaces not concealed from view by earth in completed structure, except where otherwise indicated on Drawings. Walls that will be exposed after future construction, at locations indicated on Drawings, shall have smooth form finish. Smooth form finish on exterior face of exterior walls shall extend 2 feet below final top of ground elevation. Exterior face of all perimeter grade beams shall have smooth form finish for full depth of grade beam.

D. Rubbed Finish:

1. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.
2. Remove forms as soon as practicable, repair defects, wet surfaces, and rub with No. 16 carborundum stone or similar abrasive. Continue rubbing sufficiently to bring surface paste, remove form marks and fins, and produce smooth, dense surface of uniform color and texture. Do not use cement paste other than that drawn from concrete itself. Spread paste uniformly over surface with brush. Allow paste to reset, then wash surface with clean water.
3. Use rubbed finish at locations indicated on Drawings, except where rubbed finish is indicated for a wall which will be containing a liquid, use spray-applied coating.

- E. Spray-applied Coating: At Contractor's option, in lieu of rubbed finish, spray-applied coating may be applied after defects have been repaired and fins removed. Remove form oil, curing compound and other foreign matter that would prevent bonding of coating.

Apply coating in uniform texture and color in accordance with coating manufacturer's instructions.

- F. Related Unformed Surfaces: Tops of piers, walls, bent caps, and similar unformed

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surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to texture reasonably consistent with that of formed surfaces. Continue final treatment on formed surfaces uniformly across unformed surfaces.

3.04 HOT WEATHER FINISHING

- A. When hot weather conditions exist, as defined by Section 03310 - Structural Concrete and as judged by the Owner's Representative, apply evaporation retardant to the surfaces of slabs, topping and concrete fill placements immediately after each step in the finishing process has been completed.

3.05 FINISHING SLABS AND SIMILAR FLAT SURFACES TO CLASS A, B, AND C TOLERANCES

- A. Apply Class A, B, and C finishes at locations indicated on Drawings.
- B. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. See Section 03100 – Concrete Formwork for edge forms and screeds.
- C. Consolidation and Leveling: Concrete to be consolidated shall be as stiff as practicable, thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not permit manipulation of surfaces prior to finishing operations.
- D. Tolerances for Finished Surfaces: Check tolerances by placing straightedge of specified length anywhere on slab. Gap between slab and straightedge shall not exceed tolerance listed for specified class.

<u>Class</u>	<u>Straightedge Length in Feet</u>	<u>Tolerance in Inches</u>
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A	10	1/8
B	10	1/4
C	2	1/4

E. Raked Finish: After concrete has been placed, struck off, consolidated and leveled to Class C tolerance, roughen surface before final set. Roughen with stiff brushes or rakes to depth of approximately 1/4 inch. Notify Owner's Representative prior to placing concrete requiring initial raked surface finish so that acceptable raked finish standard may be established for project. Protect raked, base-slab finish from contamination until time of topping. Provide raked finish for following:

1. Surfaces to receive bonded concrete topping or fill.
2. Steep ramps, as noted on Drawings.
3. Additional locations as noted on Drawings.

F. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or corkfaced floats in locations inaccessible to power-driven machine and on small, isolated slabs.
2. After initial floating, re-check tolerance of surface with 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots to Class B tolerance. Immediately re-float slab to a uniform, smooth, granular texture.
3. Provide float finish at locations not otherwise specified and not otherwise indicated on Drawings.

G. Trowel Finish:

1. Apply float finish as previously specified. After power floating, use power trowel to produce smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional troweling by hand after surface has hardened sufficiently. Do final troweling when ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling operations.

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2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to Class A tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.
3. Provide trowel finish for floors which will receive floor covering and additional locations indicated on Drawings.

H. Broom or Belt Finish:

1. Apply float finish as previously specified. Immediately after completing floated finish, draw broom or burlap belt across surface to give coarse transverse scored texture.
2. Provide broom or belt finish at locations indicated on Drawings.

3.06 FINISHING SLABS AND SIMILAR FLAT SURFACES TO "F-NUMBER SYSTEM" FINISH

- A. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. Edge forms and screeds: Conform to Section 03100 - Concrete Formwork.
- B. Consolidation and Leveling: Concrete to be consolidated shall be as dry as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not manipulate surfaces prior to finishing operations.
- C. Tolerances for Finished Surfaces: Independent testing laboratory will check floor flatness and levelness in accordance with Paragraph 3.12, Field Quality Control.
- D. Float Finish:
 1. After concrete has been placed, struck off, consolidated, and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven flat. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.

2. Check tolerance of surface after initial floating with a 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots. Immediately refloat slab to uniform, smooth, granular texture to F_F20/F_L17 tolerance, unless shown otherwise on Drawings.
3. Provide “F-Number System” float finish at locations indicated on Drawings.

3.07 BONDED CONCRETE TOPPING AND FILL

A. Surface Preparation:

1. Protect raked, base-slab finish from contamination until time of topping. Mechanically remove oil, grease, asphalt, paint, clay stains or other contaminants, leaving clean surface.
2. Prior to placement of topping or fill, thoroughly dampen roughened slab surface and leave free of standing water. Immediately before topping or fill is placed, scrub coat of bonding grout into surface. Do not allow grout to set or dry before topping or fill is placed.

B. Concrete Fill:

1. Where concrete fill intersects a wall surface at an angle steeper than 45 degrees from vertical, provide a 1.5-inch deep keyway in the wall at the point of intersection; size keyway so that no portion of the concrete fill is less than 1.5 inches thick. Form keyway in new walls; create by saw cutting the top and bottom lines and chipping in existing walls.
2. Apply wood float finish to surfaces of concrete fill.
3. Provide concrete fill at locations shown on Drawings.

C. Bonded Concrete Topping in Bottom of Clarifiers and Thickeners:

1. Minimum thickness of concrete topping: 1 inch. Maximum thickness when swept in by clarifier and thickener equipment: 3 inches.
2. Compact topping and fill by rolling or tamping, bring to established grade, and float. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. Coat

surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.

3. Screed topping to true surface using installed equipment. Protect equipment from damage during sweeping-in process. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. After topping has been screeded, apply wood float finish. During finishing, do not apply water, dry cement or mixture of dry cement and sand to the surface.
4. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Owner's Representative, fill the tank with sufficient water to cover the entire floor for 14 days.
5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

3.08 EPOXY PENETRATING SEALER

- A. Surfaces to receive epoxy penetrating sealer: Apply wood float finish. Clean surface and apply sealer in compliance with manufacturer's instructions.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: Apply minimum 2-inch-high coverage of floor coating on vertical surface.
- C. Mask walls, doors, frames and similar surface to prevent floor coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.
- E. Provide epoxy penetrating sealer at locations indicated on Drawings.

3.09 EPOXY FLOOR TOPPING

- A. Surfaces to receive epoxy floor topping: Apply wood float finish unless recommended otherwise by epoxy floor topping manufacturer. Clean surface and apply epoxy floor topping in compliance with manufacturer's recommendations and instructions. Thickness of topping:
1/8 inch.
- B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots:

apply 2-inch- high coverage of floor coating on vertical surface.

- C. Mask walls, doors, frames and similar surfaces to prevent floor coating contact.
- D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cover.
- E. Finished surface shall be free of trowel marks and dimples.
- F. Provide epoxy floor topping at locations indicated on Drawings.

3.10 SEALER/DUSTPROOFER

- A. Where sealer or sealer/dustproofers is indicated on Drawings, just prior to completion of construction, apply coat of specified clear sealer/dustproofing compound to exposed interior concrete floors in accordance with manufacturer's instructions.

3.11 NONSLIP FINISH

- A. Apply float finish as specified. Apply two-thirds of required abrasive aggregate by method that ensures even coverage without segregation and re-float. Apply remainder of abrasive aggregate at right angles to first application, using heavier application of aggregate in areas not sufficiently covered by first application. Re-float after second application of aggregate and complete operations with troweled finish. Perform finishing operations in a manner that will allow the abrasive aggregate to be exposed and not covered with cement paste.
- B. Provide nonslip finish at locations indicated on Drawings.

3.12 FIELD QUALITY CONTROL

- A. Flatness and levelness of slabs and similar flat surfaces that are indicated on Drawings to receive "F-Number System" finish will be checked by independent testing laboratory employed by Owner in accordance Section H.
- B. Tolerances for "F-Number System" finished surfaces:
 - 1. Floor tolerance shall be determined in accordance with ASTM E 1155.
 - 2. Floor flatness and levelness tolerances:
 - a. F_F defines maximum floor curvature allowed over 24 inches.

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Computed on the basis of successive 12-inch elevation differentials, F_F is commonly referred to as the "flatness F- Number."

$$F_F = \frac{4.57}{\text{Maximum difference in elevation, in decimal inches, between successive 12-inch elevation differences.}}$$

- b. F_L defines relative conformity of floor surface to horizontal plane as measured over 10-foot distance. F_L is commonly referred to as "levelness F-number."

$$F_L = \frac{12.5}{\text{Maximum difference in elevation, in inches, between two points separated by 10 feet.}}$$

3. Achieve specified overall slab tolerance. Minimum local tolerance (1/2 bay, unless otherwise designated by Owner's Representative): 2/3 of specified tolerance.
4. Tolerance for floated finish: F_F20/F_L17 , unless otherwise shown on Drawings.
5. Tolerance for troweled finish: F_F25/F_L20 for slabs on grade, and F_F25/F_L17 for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

- A. Conform to requirements of Section 03390 - Concrete Curing.

END OF SECTION

SECTION 03604
NON-SHRINK GROUT

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Specification 16012 “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 REFERENCES

- A. U.S. Army Corps of Engineers (CRD):
 - 1. C621-89 - Specification for Non-Shrink Grout.
- B. American Society for Testing and materials (ASTM):
 - 1. C 1107 REV A-91 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

1.02 SUBMITTALS

- A. Submit all products covered under this specification for Engineer’s approval.
- B. Product Data:
 - 1. Manufacturer’s literature.
- C. Submit in accordance with Section 01340.
- D. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS
NON-SHRINK GROUT

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufactures:

1. Five Star Grout, U.S. Grout Corporation.
2. Sealtight 588 Grout, W.R. Meadows, Inc.
3. Masterflow 713 Grout or Set Non-Shrink Grout, Master Builders.
4. SonogROUT, Sonnebom Contech.
5. SikagROUT 212, Sika Corporation.
6. Euco N-S Grout, Euclid Chemical Company.
7. Unisorb V-1 or V-2, Non-Shrink Grout, Unisorb Machinery Installation Systems.
8. Multi-Purpose Construction Grout, Symons.
9. DuragROUT, L&M Construction Materials, Inc.
10. Or equal.

B. Grout:

1. Cement base, nonmetallic, non-gas forming, non-shrink, pre-blended and ready-to-use requiring only addition of water at Project site.
2. Comply with ASTM C1107 and CRD C621, Grade B or C.
3. Of moderate fluidity with minimum compressive strength of 5,000 psi at 28 days and shall not bleed.

C. Water:

1. Clean and free from injurious chemicals and deleterious materials.

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NON-SHRINK GROUT

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough.
- B. Underside of base plates of machinery, rails, and bolts shall be free of grease, oil, dirt or coatings.

3.02 MIXING AND PLACING

- A. Mix and place in accordance with manufacturer's written instructions.
- B. Provide sealing materials where necessary to retain grout until hardened.
- C. Work grout from one side to other. Avoid trapping air under base plates.
- D. Remove plastic anchor bolt sleeve tops where used, and fill with grout at same time base plates are grouted.

3.03 CURING

- A. Cure with curing compound or as recommended by grout manufacturer.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Galvanized steel platform and access ladder.

B. Related Sections:

1. Section 03604 – Grout: Grouting under Base Plates and Bearing Plates.
2. Section 05120 – Structural Steel.
3. Section 05210 – Steel Joists.
4. Section 05300 – Metal Decking.
5. Section 05400 – Cold Formed Metal Framing.

1.02 REFERENCES

- A. Welding: Meeting requirements of AWS “Structural Welding Code”, latest edition.
- B. Stairways: Meet requirements of standard construction details of “Metal Stairs Manual” of the National Association of Architectural Metal Manufacturers.
- C. All railings, stairs, and ladders shall meet requirements of OSHA, UBC, and UFAS.

1.03 DEFINITIONS

A. Metal Fabrications:

1. Synonymous with miscellaneous metals.
2. Metal fabrications for items fabricated from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.

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METAL FABRICATIONS

- B. Exposed Structural Steel: As used under this section, includes all metal fabrications exposed to view.

1.04 SUBMITTALS

- A. Shop Drawings:

- 1. Submit shop drawings for custom fabricated items, including:
 - a. Profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories.
 - b. Erection drawings, elevations and details.
 - c. Welded connections using standard AWS welding symbols.

- B. Product Data: Submit product data for manufacturer's stock items.

- C. Certifications:

- 1. Submit current welder's certification qualified in accordance with ASW D1.1.
- 2. Submit certification by fabricators that handrails and stairs have been designed by a structural Engineer licensed in the State of Texas.

- D. LEED MRc5: Regional Materials

- 1. Provide a statement from the manufacturer stating the materials provided were manufactured within a 500 mile radius of the project. Include location.

- E. LEED MRc4: Recycled Content

- 1. Provide a statement from the manufacturer including recycled content percentage, by weight, and whether the recycled content is post-consumer or post-industrial.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Experienced in fabrication of miscellaneous steel.

- B. Welder Qualifications: Welding shall be done only by certified welding operators currently qualified according to ASW DI.1.

- C. Engineering Qualifications:

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METAL FABRICATIONS

1. Professional Engineer licensed to practice in the State of Texas and experienced in providing structural engineering services that have resulted in the successful installation of metal fabrications similar in material, design, and extend to that indicated for this project. Structural Engineer is to provide sealed drawings for structural assembly of elevated platform to support generator and motor control center. This work includes a steel canopy on the elevated platform. Submittals should show any variations in structural design that are necessary to provide the structures intended by the plans and specifications.
- D. Design Criteria:
1. Refer to standard details, following this section.
 - a. Exterior railings.
 2. Steel Stairs:
 - a. Minimum Uniform Load: 100 psf.
 - b. Minimum Concentrated Load: 300 lbs. at any point.
 - c. Engineer of Record shall approve/design connections.
 3. Handrails:
 - a. Minimum Uniform Load: 50 plf.
 - b. Minimum Concentrated Load: 200 lbs. at any point.
 - c. Engineer of Record shall approve/design connections.

PART 2 - PRODUCTS

2.01 MANUFACTURED ITEMS

- A. Elevated steel platform as shown on plans.
 1. Galvanized steel structural materials.
- B. Steel Stairs – (Where Shown on Plans).
 1. Grate Tread Channel Stringer Stairs: Industrial-type steel stairs.

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METAL FABRICATIONS

- a. 14 gage, 2” depth channel “Grip Strut Safety” as manufactured by McNichols Co. or equal substitute.
 - C. Tubular Steel Railings:
 - 1. Size: Fabricated from 1-1/4” NPS round steel pipes with steel balusters. Galvanized after fabrication.
 - a. Exterior railings.
 - D. Steel Ladders (where applicable):
 - 1. Side Rails: Fabricated from minimum 3/16-inch steel bar.
 - 2. Rungs: 1-inch steel pipe at 12” o.c., minimum, welded to side rails.
 - 3. Width: 20-inches minimum width, spaced 7-inches minimum from wall or structure.
 - 4. Maximum unbraced vertical length is 6 feet.
 - 5. Comply with ANSI A14.3 requirements.
 - 6. Galvanized after fabrication.
 - E. Floor Grating:
 - 1. Support grating on galvanized steel angles with universal clip fastener. Clip bolt shall be galvanized.
 - 2. Type: Welded carbon steel grating capable of supporting 150 psf at a span shown on plans for each particular application. Galvanize after fabrication with G90 coating per ASTM A386.
- 2.02 FABRICATION
- A. General: Fabricate in accordance with details and reviewed shop drawings, all miscellaneous items of metal work indicated or as necessary to complete the work. Verify dimensions on site prior to shop fabrication.
 - B. Welding: Comply with latest American Welding Society standards. Miter and cope intersections and weld all around. Remove spatter, grind exposed welds to bend, and contour surfaces to match those adjacent.

2.03 SHOP PAINTING – (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 SCHEDULE

- A. This section includes, but is not specifically limited to metal fabrications and components listed in the following schedule:
1. Miscellaneous anchor slots, sleeves, bolts, brackets, clips, inserts, imbeds, gratings, tubing, bar stock, plates and other items not distinctly specified under other sections.
 2. Steel structural beams and columns
 3. Loose steel angle lintels.
 4. Steel stairs (Where Shown on Plans).
 5. Handrail brackets, handrails and guard rails.
 6. Steel ladders.
 7. Foundations.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ANCHOR BOLTS, EXPANSION ANCHORS AND ADHESIVE ANCHORS

SECTION 05503

ANCHOR BOLTS, EXPANSION ANCHORS AND ADHESIVE ANCHORS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope. This section covers cast-in-place anchor bolts, adhesive anchor bolts and expansion anchors to be installed in hardened concrete.

1.02 MEASUREMENT AND PAYMENT

- A. Unless noted in the Bid sheet, no separate payment will be made for work under this section. Include payment in unit price for applicable work as noted on the Bid sheet.

1.03 QUALITY ASSURANCE

- A. Acceptable Manufacturers. Adhesive and Expansion Anchors shall be Hilti or Approved Equal.

1.04 SUBMITTALS

- A. Submit anchor data and drawings.

PART 2 – PRODUCTS

2.01 MATERIALS

Bolts and Nuts	Stainless Steel ASTM A193, Grade 316.
Flat Washers	ANSI B27.2; of the same material as bolts and nuts.
Expansion Anchors	Stud type with three section wedge, Hilti 316 stainless steel Kwik- Bolt II, or equal.

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Adhesive Anchors Two-component epoxy resin, contained in two plastic cartridges separating the resin from the hardener, Hilti HIT HY-150 System with stainless steel threaded anchor or equal.

Sleeves Plastic or Stainless Steel.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Anchor Bolts. Except where specifically shown or specified otherwise, cast-in-place anchor bolts shall be a sleeved "J" type 316 stainless steel at least 3/4 inch in diameter except where specifically shown or specified otherwise, the minimum embedment of a cast-in-place anchor bolt shall be 24 bolt diameters. Upon approval of the Engineer, plate type anchor bolts with an pullout strength equal to a fully developed, type "J" bolt shall be used where the minimum embedment length is not available. Contractor shall verify type, size and location of anchor bolts with Engineer prior to placement.
- B. Expansion Anchors. Expansion anchors shall not be used except where explicitly called out on the Drawings or accepted in writing by the Engineer. Unless otherwise noted the expansion anchors shall be as follows:

<u>Anchor Diameter, in.</u>	<u>Minimum Embedment, in.</u>	<u>Minimum Ultimate Tensile Strength, lbs.</u>	<u>Minimum Ultimate Shear Strength, lbs.</u>
1/2	6	8,600	8,340
5/8	7	13,700	12,500
3/4	8	17,000	18,000
1	10	35,200	28,050

- C. Adhesive Anchors. Adhesive anchors shall be used where shown on the Drawings or accepted by the Engineer. Unless otherwise noted the anchors shall be as follows:

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ANCHOR BOLTS, EXPANSION ANCHORS AND ADHESIVE ANCHORS

<u>Anchor Diameter, In</u>	<u>Minimum Embedment in</u>	<u>Minimum Ultimate Bond Strength, lbs.</u>
1/2	6 3/8	13,600
5/8	7 1/2	17,500
3/4	10	28,000
7/8	10	29,650
1	12 3/8	50,000

PART 3 – EXECUTION

3.01 ANCHOR BOLTS

- A. All anchor bolts shall be delivered in time to permit setting when structural concrete is placed. Anchor bolts which are cast-in-place shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or supporting template. Two nuts shall be furnished for each anchor bolt. Clearance to edge of concrete shall be a minimum of six bolt diameters or 4 inches, whichever is greater.

3.02 EXPANSION ANCHORS

- A. Expansion anchors shall not be used except where explicitly called out on the Drawings or accepted in writing by the Engineer. Install expansion anchors as per recommendation of manufacturer. Drilled hole diameters shall not exceed the bolt diameter. Clearance to edge of concrete shall be a minimum of six bolt diameters, or 4-inches, whichever is greater.

3.03 ADHESIVE ANCHORS

- A. Install adhesive anchors as per recommendation of manufacturer. The adhesive shall be dispensed through a static mixer nozzle into holes drilled with carbide tipped drill bits. Clearance to edge of concrete shall be a minimum of six bolt diameters or 4 inches, whichever is greater.

END OF SECTION

SECTION 13426

PROPELLER METER

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work”, Paragraph 1.04 – “Submittals,” Item F for submittal requirements.

1.01 SUMMARY

- A. Section Includes:
 - 1. Propeller meter in pump discharge piping.
 - 2. Flow Transmitter Adapters
- B. Install compatible signal adapter with 4-20 MA output on existing propeller type flow meter field verify exact requirements. .

1.02 SUBMITTALS

- A. Product Data: Submit to Engineer for approval. See Section 16013 – “Electrical Submittals” for submittal requirements.
- B. Operation and Maintenance Data:
 - 1. Operating instructions, maintenance procedures and parts list.
 - 2. Submit to Engineer for approval. See Section 16012 – “Electrical Work” or Section 16014 – “O&M Manual” for O&M Manual requirements.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

PROPELLER METER

-
- C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Water specialties
- B. Sensus
- C. Or equal.

2.02 GENERAL

- A. Propeller meter flow transmitter adaptor of size to fit existing meter.
 - 1. Accuracy of $\pm 2\%$ of actual flow.
 - 2. Able to exceed normal flow range by 50% for safe intermittent usage without loss of accuracy.
 - 3. Steel body for 150 psi working pressure.
 - 4. Flow transmitter assembly removable without removing meter body from line.
 - 5. Corrosion and wear-resistant working parts.
 - 6. Instantaneous flow rate indicator in gallons per minute.

2.03 TRANSMITTER

- A. Provide 2 wire, 4-20 MA signal transmitter on flow meter. Transmitter manufacture is to be same as meter manufacturer or, be pre-approved equal.
 - 1. Water specialties Model TR-16.
 - 2. Sensus Model OMNI T2 with electronic register or, to match meter body.
 - 3. Or equal, that is manufactured for use with proposed or existing meters.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

PROPELLER METER

-
- B. Route flow signal to MCC ASP section and to SCADA PLC. .
 - C. Provide two (2) shielded wire supply power to totalizer and to SCADA or recorder as shown on plans.

2.04 PAINTING

- A. Shop and Field Coat Exterior: Color to match adjacent piping or existing meter.
- B. Interior: Shop applied fusion epoxy, 12-15 mils, approved by NSF for use with potable water (where applicable).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions and approved submittals.
- B. When transmitter is installed on meter, Contractor shall be responsible for assuring meter is completely dry internally before installing transmitter. Where meter has to be removed and dried in shop, Contractor shall provide a loaner meter to maintain Owner's flow during period original meter is removed. Original meter shall be adjusted to read totalized flow that includes period of removal.
- C. Transmitter and/or meter shall be field set-up, calibrated, and tested by a trained Factory Technician.
- D. Operator shall be capable of visual reading of propeller flow meter after adapter is installed.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Manufacturer's Technician for equipment specified herein shall be present at job site for equipment set-up, calibration, and training of Owner's personnel for operation and maintenance of equipment.
 - 2. Equipment shall not be repaired from time deliver through warranty period. Any failed or damaged equipment shall be replaced with new equipment. Repairs shall only be performed by a Factory Technician or as approved by Engineer.

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PROPELLER METER

3.03 **WARRANTY**

- A. Provide warranty in accordance with Section 16012 – “Electrical Work,” Paragraph 3.06.

END OF SECTION

SECTION 13438

GAUGES AND THERMOMETERS

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Specification 16012 “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Standards of construction for gauges and thermometers referenced to this section from other sections shall conform to requirements of this section.
 - 2. Construction materials of gauges and thermometers referenced to this section from other sections shall be in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Ashcroft.
 - 2. U.S. Gauge, Division of Ametek, Inc.
 - 3. Or equal.
- B. Provide pressure gauges as indicated in Schedule 1 to this section.
- C. Gauge shall be dial-indicating type utilizing Bourdon tube actuation system of bronze construction.
- D. Dial Size: 7 in.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GAUGES AND THERMOMETERS

- E. Gauge Accuracy: 2.0% of span.
- F. Gauge Case: Steel or Aluminum with glass window.
- G. Bottom stem mounted gauges with 1/4 in. NPT connection.
- H. Provide gauges with adjustment for zero reading.
- I. Provide gauges with diaphragm seals where shown on plans and as indicated in Schedule 1 to this section.
 - 1. Diaphragm Seal:
 - a. Continuous duty type with top housing of carbon steel and bottom housing and diaphragm of Type 316 stainless steel.
 - b. Provide with 1/2 in. NPT threaded inlet, 1/4 in. NPT gauge connection, and 1/4 in. NPT flushing connection.
 - c. Combined accuracy of diaphragm seal and gauge shall be ∇ 3.0% of span.
 - d. Provide with shutoff 1/2 in. ball valve of materials suitable for application.
- J. Provide snubber for gages installed on pump discharge lines.

2.02 THERMOMETERS – (WHERE SHOWN ON PLANS)

- A. Manufacturers:
 - 1. Ashcroft, Dresser Industries.
 - 2. U.S. Gauge, Division of Ametec, Inc.
 - 3. Or equal.
- B. Provide thermometers where shown on Drawings and as indicated in Schedule 2 to this section.
- C. Bimetal or vapor filled.
- D. Dial Size: 3.5 in. any angle for bimetal, 4.5 in. filled system.
- E. Accuracy: ∇ 1% full scale.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GAUGES AND THERMOMETERS

- F. Construction: Case-stem-connection 300 series stainless steel for bimetal case aluminum with 300 series armored capillary and bulb for filled system.
- G. Bimetal and filled system with 1/2 in. NPT connection into Type 316 stainless steel thermoweld with 1 in. NPT connection to process.
- H. External zero adjustment.

2.03 TAGGING

- A. Provide Type 316 stainless steel tag permanently affixed to each unit.
- B. Engrave with process application as listed in specifications or as shown on plans.
- C. Include Engineer's tag number where listed in specifications or where shown on P&ID's.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with Drawings, manufacturer's written instructions, and approved submittals.

END OF SECTION

SECTION 16012
ELECTRICAL WORK

PART 1 GENERAL

1.01 CONDITIONS

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1.02 Contractor shall comply with programming allowance requirement of:

- A. Item 1.07 – “Contractor’s Responsibilities” of this specification section.
1. **Item 3.07 – “Field Quality Control” of Section 16662 – “Motor Management Relay (Multilin)”**
 2. **Item 1.00 – “Conditions” of Section 16904 – “Controller”**
 3. **Item 1.01 – “Work Included” of Section 16904 – “Controller”**

Contractor or his Subcontractors are not responsible for contents of program. Warranty for operation of program is solely the responsibility of the Engineers Integrator/Programmer. There are to be no contractual agreements between the Contractor and/or his Subcontractors and the s Integrator/Programmer. Provide programming allowance per Item 1.07 – “Contractor’s Responsibilities.” Contractor is bound to coordination of various equipment installations and operation so as to not delay scheduled installation and testing of programs. Review all electrical related Specifications for schedule requirements of programming activities.

- B. Contractor shall verify requirements of Item 2.01 – “Materials” before bidding.
- C. **Contractor to conform to Item 1.06 – “Contractor Qualifications” of this specification before bidding.**
- D. General Contractor is solely responsible for coordinating all electrical requirements of all equipment installed under this contract.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL WORK

- E. Electrical Subcontractor shall confirm this with General Contractor before bidding. Within 10 days of “Notice to Proceed,” the General Contractor shall appoint a person responsible for coordination of all electrical controls and equipment that are a part of this project and shall, at that time, notify Engineer in writing of that person’s name, telephone number, fax number, address, and all other pertinent information.
- F. This specification section is an inherent part of all work performed on this project and its contents shall apply for any and all electrical power, control and instrumentation related work. Contractor shall advise all Subcontractors and Vendors accordingly.
- G. Warning: Electrical systems for this project have lethal voltages present. Contractor shall not work on energized equipment except when absolutely necessary and then only in the presence of another trained, experienced Electrician and with proper protective gear. See Item 1.06 – “Contractor Qualifications” for safety training requirements.
- H. All correspondence, RFI’s, and submittals concerning electrical, instrumentation, and controls matters shall be from General Contractor and shall have statement that General Contractor has verified the correctness or validity of the correspondence, etc. in respect to contractual requirements of the plans and specifications. Any correspondence, etc. not having this statement or determined to be covered in the requirements of the plans and specifications will not be responded to and the Contractor shall be fully responsible for any action or non-action thereof.
- I. All references to “days” in the electrical, mechanical, instrumentation, and controls specifications means “working days.” All prequalification under this specification shall be submitted no later than ten (10) days prior to bid date.
- J. Installation shall conform to most recent National Electrical Code, International Building Code, and Local Codes. In addition, Contractor shall follow all requirements of NFPA 70E - “Standard for Electrical Safety in the Work Place.” Of specific importance are all the requirements of Article 400.11 – “Flash Protection.”
- K. Plans and diagrams are illustrative and may not contain all devices wiring and controls required to perform the function intended without reference to Specifications. Location and alignment of motor control centers or other equipment shown on Plans may require adjustment for some Equipment Manufacturers products, and this requirement is the Contractors sole responsibility.

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ELECTRICAL WORK

- L. Substitutions for equipment specified or shown on plans shall be as pre-approved prior to bidding unless specified or shown on plans as “or equal.” Where noted as “pre-approved,” indicates approval is required prior to bid acceptance.
- M. All software or programs provided by any Vendor or Contractor shall be open activation without undisclosed passwords, keys, and/or means or devices that prevent Owners access to programs. All software shall be new copies for Owner with no cost attachments. No exceptions.
- N. All references to plans and/or drawings refer to the complete set of contract plans and not specifically electrical only, unless stated otherwise.
- O. Additions or modifications to existing facilities involves a degree of uncertainty and all existing, hidden or unknown conditions may not appear on plans. Contractor is to consider this when bidding and shall cover all reasonable unknown conditions not evident in pre-bid site visit, which is necessary to familiarize Contractor with observable pre-existing conditions. Contact Engineer concerning any questions prior to bidding job.
- P. Control panels, MCC’s and electrical equipment shall be fabricated to fit the available space shown on plans. Install control panels, instruments, and motor control centers to allow a minimum of four (4) foot clearance for access to control devices. This may require special enclosures. Relocation up to 40 feet from where shown on plans may be required and shall be included in bid cost. Supplier and Contractor shall notify Engineer of any variations in size, location or orientation before fabricating equipment. Listing of acceptable Equipment Manufacturers does not limit or remove the intent of this requirement.
- Q. All devices, fittings, connectors, supports, brackets, and miscellaneous hardware normally used for installation of electrical equipment may not be shown in detail. Contractor shall provide all these items and included them in bid price.
- R. Any change orders or additional work beyond the scope of this project as bid by Contractor shall be approved in writing by Engineer. Any unapproved work performed is at Contractor’s risk.
- S. Installation shall conform to layout, routing, and details shown on Plans and described in Specifications. Any variations shall be pre-approved in writing by Engineer before work starts. Any unauthorized work shall be removed at Contractor’s cost and with no delay in project schedule.

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ELECTRICAL WORK

1.03 DESCRIPTION

- A. The work shall include providing materials and equipment required for installation of a complete and functioning electrical system as specified and as shown on the drawings.
- B. This section is an integral part of all Specification Sections related to electrical, control and instrumentation construction under this contract. Contractor shall check all other plans and specifications for this project and include items and circuits accordingly. The total set of construction documents make up the requirements for work for this project and shall be included in Contractor's bid at no additional cost to Owner or Owner's Representative.
- C. All plans and specifications for this project are representative of the design intent and may not contain minute details associated with normally accepted electrical construction, as described in applicable codes or as described in manufacturer's literature. Contractor shall provide all appurtenances normally associated with a particular equipment or device, and as required for a proper operating system. Some devices, equipment or materials may appear in only one location on the plans or in the specifications. Each and every item shown or described is to be included for this project. No exceptions. All required circuits and devices necessary for intended operation are to be included without additional cost to Owner. Where discrepancies occur between various plans or specifications for this project and where clarification is not requested by Contractor prior to bidding, the most stringent requirement shall be included in the Contractors bid price. Contractor shall review all specifications for all trade disciplines with electrical requirements prior to bidding and shall include most stringent and higher cost requirements in bid price. No elements or requirements of the plans or specifications shall be omitted in Contractor's bid price unless specifically deleted in writing by Engineer. Failure to follow this specification requirement is at Contractor's expense and at no additional cost to Owner.
- D. Prior to bidding and during construction, Contractor shall coordinate with equipment vendors and suppliers and determine requirements for power, control and interconnection wiring and shall provide conduits and conductors accordingly for a complete operating system.
- E. All electrical work shall be performed only by a Texas State Licensed Electrical Contractor, and as listed in Item 1.06 – "Contractor Qualifications" of this Section.

1.04 MAJOR ITEMS OF WORK AS FOLLOWS

- A. All work shown on plans and described in specifications including as follows:

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ELECTRICAL WORK

1. Demolition of existing equipment as shown on plans.
 2. Installation of SCADA PC, screen and interface circuits at old mcc room.
 3. Installation of cabinets in old mcc room.
 4. Route interface circuits from old mcc room to new mcc.
 5. Installation of new motor control center on elevated platform.
 6. Installation of lighting and receptacles.
 7. Installation of pump motor feeders and control circuits.
 8. Installation of natural gas generator on elevated platform.
 9. Installation of gas metering and piping to generator. Coordinate with CPE.
 10. Installation of signal circuits from Authority metering station to new mcc.
 11. Installation of electrical service equipment. Coordination with CPE.
 12. Relocation of automatic transfer switch.
 13. Installation of autosensory controls with solid-state pump controller.
 14. Installation of GST and HT panels, instruments, and circuits.
 15. Installation of telephone circuit and automatic telephone dialer.
 16. Modifications of booster pumps and electrical systems in pump room.
 17. Modification of chemical equipment in chemical room and on site.
 18. Installation of all other miscellaneous electrical systems, as shown on plans.
- B. Contractors shall attend coordination meeting with Engineer to review construction methods, plans and specifications before starting work. Prior to start of work, Contractor to provide schedule showing all phases of work, including completion, testing and required programming schedule as described in Item 3.08 – “Testing and Startup,” of this specification.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL WORK

1.05 PLANT CONTROL SYSTEM

- A. The Contractor shall furnish and install a complete operating control system. The control system shall include but shall not be limited to all circuit breakers, motor starters, alternator, contactors, indicating lights, selector switches, surge protector, phase failure relays, programmable controllers, alarm light and horn, push buttons, control transformer, electronic devices, sensors, interlock wiring, control relays, blocks, snubbers, valves, nameplates, and all other associated items required to provide a workable system. All control circuits to be “fail-safe” type.
- B. Provide circuit conductors, conduits, circuit breakers, and related devices for furnishing power to all motor heaters, instruments, devices, lights, controls, and all other motors and equipment indicated on plans or provided by Vendors or others for this project. Provide circuits and related devices per Code.
- C. All controls shall be fully tested in shop for proper and satisfactory operation, prior to installation at site. Contractor to provide written certification before delivery to site. Any installations without certification notice are done at risk by Contractor, who shall be obligated to make all necessary corrections in field at no additional cost to owner.
- D. Where any equipment includes a Manufacturer furnished control panel the Equipment Vendor or Manufacturer shall be responsible for coordination of all interconnecting wiring at related devices.
- E. Provide interlock circuits between vendor furnished equipment, control panels and pump starters. This includes interlocks for booster pump controls. Coordinate with each vendor. Provide interlock circuits with adjustable time delay devices.
- F. Provide block and bleed valves for level and pressure devices. Route bleed line to outside building or enclosure.
- G. All multiple pump installations shall have means of alternating pumps and provisions for bypassing pumps not in service in primary and backup mode of operation.
- H. All CT's to have means for limiting voltage level at CT terminals in event load disconnected while CT is energized. This is required for personnel safely.
- I. All control device settings are to be adjusted by Contractor for values recommended by the Plant Operator. Contact Engineer if clarifications needed.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL WORK

1.06 CONTRACTOR QUALIFICATIONS

- A. Contractor, Subcontractors, and Controls Vendors shall be experienced with all types of electrical systems covered under this contract. No work shall be undertaken where Contractor's firm, project supervisors and project electrical workers have not had recent experience in similar projects in area of project location. Electrical contractors, electricians, inspectors, installers, and programmers assigned to this project shall be full time qualified employees. Contract type employees are not allowed unless preapproved by Engineer. Contractor will be required to furnish proof of experience and employment where requested by Owner or Engineer or their Representatives. Pre-qualified Electrical Contractors are listed in Item 1.06, Paragraph E of this section.
- B. Contractor's Project Manager or his Assistant shall be familiar with types of electrical construction required by this project in order to determine that all subcontractor and vendor's work is in conformance with the plans and specifications.
- C. Electrical Contractor shall have Master Electrician License for City or County; in which project is located, and shall have a State issued Master Electrician License.
- D. Contractor shall have an established safety-training program in effect for the duration of this project and will be required to submit proof of safety training for all employees working on this project.
- E. The following Contractors are considered qualified and acceptable for electrical construction:
 - 1. Pfeiffer & Son, Ltd.
 - 2. W.W. Payton
 - 3. McDonald Electric, Inc.
 - 4. Clarion Electric
 - 5. Systems, Inc.
 - 6. Industrial Electrical Services (IES)
 - 7. Resco Electric, Ltd.
 - 8. Or, as pre-approved in writing 5 days before bid date.

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ELECTRICAL WORK

1.07 CONTRACTOR’S RESPONSIBILITIES

- A. Contractor shall coordinate electrical power, natural gas, telephone, data, or special purpose line installation with utility companies. Within 30 days after award of contract, the Contractor shall contact utility company and Owner and shall request service needed. It is Contractor’s sole responsibility to assure that utility company and Owner are notified and are kept aware of requirements. Advise Owner of exact voltage and phase service required when completing application for service.

Owner and Engineer shall be advised in writing of Utility Company Service Representative handling service order, telephone number, address and order number within 30 days of Contract Award and notice to proceed. Contractor shall notify Engineer and Owner of proposed service poles to be installed by Power Company and Contractor and shall include copy of “Outlet Location Data Statement” from Power Company before installing poles or conduits. Delays in services installed due to failure to make timely application shall be at Contractor’s expense.

- B. Contractor shall provide all conduit, conductors, and termination equipment as needed for utilities and shall coordinate with utility companies for installation requirements and shall provide installation constructed according to the utility company standards whether or not such is shown in detail or plans. Where underground service is provided by Utility Company, the Contractor shall provide service installation accordingly and shall allow for up to 100 feet of underground feeder ductbank. Work shall include all equipment and materials required for working service.
- C. Contractor shall review all sections of the plans and specifications for this project and shall note all electrical requirements for devices and equipment shown or implied, and shall provide service accordingly for a complete operating control system. Any discrepancies in Electrical or Mechanical requirements noted in various plans and specifications shall be brought to the attention of the Engineer prior to ordering equipment or materials or prior to starting construction related to the item in question. Coordination of all equipment and systems is Contractor’s sole responsibility. Failure to coordinate all equipment requirements shall be the responsibility of the Contractor, at no additional cost to Owner.
- D. Unless specifically noted otherwise, Contractor shall furnish all software. Programming will be performed by the Engineers Integrator/Programmer, as required in Section 16904 – “Controller”, or other applicable sections included for this project and, where programming is required. Contractor shall provide an “Allowance” in bid cost.

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ELECTRICAL WORK

- E. Programs will be provided for shop testing of system at fabricators facilities.
- F. Contractor is specifically responsible for coordination of all electrical, mechanical, and process systems, devices and equipment provided or installed under this contract and shall assure that all requirements by all trades are met such as to insure a complete and operating electrical, control, process or instrumentation system. Special attention shall be given to coordination of motors supplied, MCC components supplied, mechanical systems supplied, horsepower and voltage and phase requirements of each. Where motor horsepower varies from plans, Contractor shall adjust circuit and control devices accordingly. This includes verification of compatibility of all interfacing connectors and devices at new, existing, and Owner furnished equipment. Notify Engineer of any discrepancies before ordering equipment. Failure to do so may result in additional cost to Contractor.
- G. Contractor shall assure that all systems have been properly installed, adjusted and tested prior to final inspection and shall notify Engineer at time electrical installation is ready for final inspection and testing.
- H. Unless Engineer has been duly notified in writing that equipment is not ready for final testing and such is acceptable with Engineer, additional final inspections and testing will be at Contractor's expense and at no additional cost to Owner.
- I. Contractor shall fully inspect all motors and nameplates, controls, conduit, wiring devices and other items before starting work, ordering materials, or submitting shop drawings in order to verify existing conditions are as shown on plans and, shall immediately notify Engineer of any discrepancies between plans and specifications and existing conditions. Failure to do so may result in Contractor's responsibility for any required changes in construction. This includes verification of compatibility of all interfacing connectors and devices for new, existing, and Owner or Contractor furnished equipment. Notify Engineer of any discrepancies before ordering equipment. Where available review "Record" drawings before bidding where existing conditions are unknown. Where available refer to "Record" drawings during construction of this project. Note that "Record" drawings may not be available in which case Contractor is required to determine wiring connections and device types as part of this contract. Where Manufacturer's delivered motor size varies from design size shown on one-line diagram or, described in specifications, Contractor shall provide conductors, conduits, and all motor control devices sized for the delivered motor size at no additional cost to Owner. Where motor current transducers are required for use by Manufacturer control panels,

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL WORK

Contractor to provide current transducers and conductors sized by Control Panel Manufacturer at no additional cost to Owner.

- J. When work involving modifications or additions to existing plant will interrupt normal service, Contractor shall make provisions for continuous electrical service thru Contractor furnished standby generator power. Where a standby generator exists but will be temporarily out of service during construction, Contractor shall provide substitute generator power for duration of outage. In no event shall plant be without operating power or, without standby generator service. Include all transfer switches, fuel tank, fuel, attendance and appurtenances required for a complete power system as needed for interim plant operation. Where work disrupts power and/or control to new or existing equipment, furnish temporary bypass circuits, as required, to maintain equipment operation.
- K. Where power outage is required, it shall be coordinated with Operator and Engineer. An outage shall not exceed 4 hours. Contractor shall plan work and provide equipment as required to maintain electrical power to facilities.
- L. Where work involves additions, modification, demolition, or renovations to existing facilities, Contractor shall remove, relocate, and extend existing installations to accommodate new construction. This includes relocation of conduits, equipment and materials that may obstruct placement of new equipment. Existing spare conduits and equipment may not be located at exact place shown on plans. Relocations and adjustments up to 40 feet are required as part of this contract. Where spare buried conduits are to be reused, conduits shall be cleaned out of all debris before use.
- M. It further includes extension or modification of existing circuits that are related to work covered under this project. Route all existing alarms to autodialer, alarm panel, and PLC where available. Include all conduit and wiring.

Extend all existing power and control circuits as required for proper operation of electrical systems. This includes extension of pump cables and instrument cables, which may require in-place splicing. Contractor shall field observe existing conditions prior to submitting a bid to become familiar with existing conditions and shall account for any relocations or extensions in bid. Refer to “Record” drawings and existing O&M Manuals. Failure to do so is at Contractors’ risk and at no additional cost to Owner.

- N. Provide electrical circuits to all equipment as required by manufacturer. Verify location and characteristics of all equipment shown on plans and in specifications and size circuits accordingly.

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All conductors and conduits to comply with NEC Article 250 and Article 310. All terminations to vendor furnished control panels shall be done by Contractor, unless specifically noted otherwise on plans or in specific specification sections. All panel calibrations and adjustments shall be done by Vendors Representative. When preparing bid or when performing work, observe all plan sheets for vendor furnished equipment and provide all required interface wiring between various panels and/or equipment necessary for a complete operating system. Provide electrical circuits to all equipment, devices, controls, controllers, and other items shown on plans, or described in specifications. Provide circuit breaker, conductor, local disconnects, and connections to equipment in compliance with National Electrical Code. All circuits may not be shown on plans and must be verified and installed accordingly.

- O. Where any equipment performance does not conform to specifications or, where in Engineers opinion, parameters are out of tolerance or erratic in performance, the Contractor shall remove and replace equipment at no additional cost to Owner.
- P. Location of outlets and equipment shown on Drawings is approximate. Field verify exact location. **Minor modification in location of outlets and equipment is considered incidental up to distance of 40 feet with no additional compensation.**
- Q. Provide fail and problem alarms for controls and Manufacturer's equipment. Route circuits to autodialer. Provide circuits, relays, expansion modules, and programming. Route all existing alarms to autodialer where work involves modification or additions to existing equipment.
- R. Contractor shall provide the equipment necessary for locating all underground pipes, conduits, and structures before digging. All locations of intersection shall be properly staked and identified. Locating all underground lines is the sole responsibility of the Contractor and shall be at no additional cost to Owner.

Any damage to underground lines is the responsibility of the Contractor. Where obstructions are present in existing spare underground conduits to be used in this project, use video camera to determine cause of obstruction and contact Engineer for directions on how to proceed.

Review all plans prior to bidding and during construction and provide power and control requirements for all valve actuators and Manufacturer furnished panels according to the Engineer's specifications and plans for all equipment. This further includes all starters, breakers, controls, conductors, conduits, interface wiring, and devices for a complete electrical system.

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- S. Refer to contract plans and provide local disconnect switches for all motors, heaters, motor operated valves, fans and electrical equipment required for this project per National Electric Code.
- T. Change orders submitted by Contractor shall include a full technical explanation of request and shall contain statement confirming that Contractor has reviewed all plans and specifications and that all work was coordinated with other trades.
- U. All equipment, devices and other items shown or indicated on plans and described in specifications are to be provided, furnished and installed by the Contractor unless, specifically and clearly marked or noted as “N.I.C.” (Not in Contract). Failure to include all items is at Contractor’s expense and at no additional cost to Owner.
- V. Contractor shall be responsible for maintaining and adjusting all equipment for safe, damage free operation where equipment must be operated by Owner during construction. This especially pertains to existing equipment and controls that may be modified under this contract but are required to be operated by Owner. All valves, motors, and controls shall be properly locked out in a safe position to prevent inadvertent damage by Owner during the course of operating the plant. Contractor shall notify Owner in writing of any equipment that cannot be safely operated.
- W. All requirements for instrumentation and control equipment shall be reviewed by Manufacturer’s Representative prior to shop drawing submittal and, Engineer shall be notified in writing when installation and application indicated on plans may not result in satisfactory and/or accurate operation of equipment specified. Failure to abide by this requirement is at Contractor’s risk and expense.
- X. Not Used.
- Y. Where applicable, do not install fuel tanks within 50 feet of habitable buildings where prohibited by local codes. Field verify with plans before starting work.
- Z. A state licensed Electrician shall supervise all scheduled inspections.
- AA. Provide all required wire adapters for oversized feeder conductors at panels, switches, breakers, and other equipment.
- BB. Where outdoor conduit top entry to enclosures, provide CSBE seals at top of conduits to avoid water entry. This applies to service bus weatherhead entries and other applications.

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- CC. Alarm reporting devices such as automatic telephone dialers shall never be disabled once installed and put in operation or, where already installed at existing facilities. Test autodialer at end of each workday during construction period.
- DD. Methods of work and devices described in all electrical specification sections are intended to facilitate a properly constructed and operating electrical system that meets Owner's operational requirements and satisfies the requirements of local and national codes. The Electrical Engineer may approve methods or devices that vary from the requirements described in any particular specification if, in the Engineer's judgment, the installation meets the intent of the Engineer's design and, where the electrical system performance meets the general requirements of the facility operation and, where the installation is deemed to present a safe installation that does not present a danger to persons operating or maintaining the electrical installation. This variance may be authorized during the submittal or inspection stage of the project, as the Engineer deems appropriate.
- EE. All equipment, conduits, panels, and devices shall be installed in the most strict, professional manner to present a neat installation. Where a question arises concerning intent of method for installation or where details are not clear, Contractor is to contact Engineer for clarification before proceeding with work. Any work not suitable or not installed in a professional manner will be modified to an installation acceptable to Engineer and Owner at no additional cost.
- FF. Provide arc flash warning tags on all electrical equipment where required by NFPA 70E. Submit arc flash analysis for Engineers review.
- GG. All motors, motor control centers, and all other electrical equipment shall be stored in a climate-controlled area prior to installation. Space heaters in motors and equipment shall be energized while stored. After installation space heaters shall be energized at all times. See relevant specification sections for additional requirements. Contractor is liable for any corrosive damage and any defective equipment. Where Contractor fails to protect electrical equipment before and after installation on site and where excessive dust is observed inside the enclosure, Contractor shall have a factory warranty service technician clean, inspect and test unit, after which factory shall issue a written and signed statement that full factory is in effect. There are no exceptions to this requirement except to replace entire unit at Engineer's request. Any equipment, devices, or software shown or indicated on Contract Documents as required for this project, and that may be overlooked by Owner or Engineer on submittals or at Final Acceptance inspection, shall still be provided by Contractor at no cost to Owner regardless of period of time that expires before Owner requests to be furnished and installed.

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- HH. Vendors for equipment with solid-state controller shall include provisions for both hardwired and data path status, command and alarm functions included under contract without additional cost to Owner, Programmer, or Engineer.
- II. Contactor shall provide all required power, control, lighting, data and instrument circuits from sources to all miscellaneous accessories and equipment that are a normal part of process equipment, electrical equipment, mechanical equipment, generators other packaged systems furnished by manufacturers for this project. Include all materials and labor required for installation of a complete operating system in bid cost, and at no additional cost to Owner. Contractor is to coordinate these requirements with vendors and manufacturers before submitting bid. For generator and process equipment systems, this shall also include fuel source piping, including chemical or other liquid or gaseous sources and all related devices and equipment that are part of a standard or specialized installation for equipment specific to this project.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials provided under all sections of the specifications shall be new and the standard products of manufacturers regularly engaged in the production of such equipment. Motor control centers, control panels, controller panels, pump panels, blower panels, and all similar equipment shall be manufactured by a firm located within 200 miles of the project facility or, firm shall have an established full time service and repair facility located within 200 miles of project facility. Final assembly of motor control centers and control panels shall be performed at these local facilities.

All materials shall conform to the National Electrical Code and shall be approved by Engineer and listed by the Underwriters' Laboratories. Materials described by manufacturer's name and catalog number are selected to set a definite standard of design and quality to be required. There is not any intention to discriminate against a product of another manufacturer, which is equally durable in construction, similar in design, and will serve the purpose for which it is intended. All equipment, hardware, materials, motors, towers, masts, brackets, or accessories shall be installed in strict accordance with Manufacturer's instructions. Contractor shall contact Manufacturer's designated local Representative for confirmation of exact model, options, configuration and services that are to be included in bid cost. Manufacturer's Representative shall make all critical adjustments to electronic modules and controls.

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Where plans, details, or specifications indicate instructions that are contrary to Manufacturer's instructions, consult with Engineer before ordering or installing. Failure to follow the requirements of this paragraph is at Contractor's expense and at no additional cost to Owner.

- B. Materials and equipment specifications are general in coverage and may contain reference to construction items that apply in only particular situations and may not apply as a general rule for materials installed on this project. Listing of acceptable Equipment Manufacturers does not limit or remove the intent of any specification sections included for this project. Provide all required accessories required by Equipment or Materials Manufacturer for proper installation. Failure to do so is at Contractor's expense.
- C. All equipment and devices shall be installed according to manufacturer's instructions. Coordinate installation with manufacturer's representative to assure correct installation methods have been applied. Prior to submittal review, Manufacturer's Representative shall review plans and specifications and shall notify Engineer in writing where application shown on plans will not provide satisfactory and/or accurate performance. Failure to abide by this requirement shall be at Contractor's risk and cost. All equipment and materials shall be rated for the harsh Industrial, Electrical, and Mechanical environment in which installed and shall be warranted by manufacturer accordingly. **This includes all enclosures located in wastewater and water facilities, including all outdoor control panels, breaker panels, switches, junction boxes, and similar electrical equipment at other facilities which shall be NEMA 4X 316 stainless steel without exception.** This requirement is paramount to all other drawings or specification requirements unless specifically noted or, unless approved otherwise by Engineer in writing.
- D. Outdoor equipment shall not have exposed devices or controls, unless specifically called for on plans. The outer door shall cover all such items. No see thru windows are allowed unless specifically approved. All outer doors to have locking hasp and door restraint to hold door open at 90 degrees position. Keyed handles for indoor panels are only acceptable where specifically approved. All NEMA 4X equipment enclosure doors to have three (3) point latching handle and locking hasp. NEMA 4X splice box enclosures shall have quick release latches. Plexiglas inner or outer doors are not acceptable.
- E. **All PLC's, controllers, VFD's, instruments and electronic equipment installed outdoors or in unconditioned spaces shall have means of cooling to allow satisfactory operation in local environment and at conditions required by equipment manufacturer's specification.**

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All motor starters over 100 horsepower shall have forced fan cooling in the starter section as a minimum. All outdoor enclosures are to have sufficient cooling. Provide rain hood, intake louvers, insect screens, and fan motor circuits with t-stat and on/off controls.

- F. All control panels and motor control centers that are not standard manufacture, off the shelf products shall be manufactured in accordance with Plans and Specifications with high quality materials and components, bear a UL listed label, and be constructed by a UL listed shop.

2.02 Manufacturer shall have local manufacturing and/or repair facility within 200 miles and have local Service Technician that can provide prompt service when required by Owner. **Equipment Manufacturers who fabricate own panels may provide control panels for this project. Control panels will be fabricated accordingly to plans and Specifications. However, no outsourced panels are allowed except for Control Panel Manufacturers listed below. This requirement will be strictly enforced. No exceptions.** Service Technicians shall have detailed knowledge of control panels specific to this project. There are no exceptions to the requirements of this paragraph. The following Manufacturers are acceptable:

1. Weimar Manufacturing Co.
 2. B.L. Technology, Inc.
 3. W.W. Payton
 4. Ace Controls
 5. Texas Industrial Controls Manufacturing (TICM)
 6. Systems, Inc.
 7. Control Panel Manufacturers listed in other Specification Sections.
 8. Or, as preapproved in writing five days before bid date.
- B. All pressure switches and transmitters on pump discharge lines are to have “snubbers” sized to produce hydraulic delay required for satisfactory operation of controls.
 - C. Substitution items may be acceptable where deemed by Engineer to be of equal type, service, value, or suitable for a particular application. The Engineer reserves the right of decision on all substitutions unless specifications state, “no substitutions allowed”.

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- D. Equipment ratings shown on plans are the “minimum” acceptable sizes. All Equipment Manufacturer’s products may not be available in the exact rating shown, in which case next greater available size shall be provided.
- E. Not Used.
- F. Where applicable, generator connectors installed at transfer switches shall be reverse service type with exposed female sleeve type and matching generator cable connector shall be recessed male pin type. Contractor shall coordinate connector’s style and size with Owner’s existing connectors to assure compatibility. Provide cut sheets or samples to Owner for confirmation. Provide adapters where needed for proper operation.
- G. All control panels and MCC’s shall have single piece door with door-mounted devices mounted directly to door. Plexiglas plates are not acceptable. Auxiliary mounting plates shall not be used to mount devices to door. All panels must be fabricated in a neat and professional manner. Metalwork shall be performed with proper commercially available tools, with no hacksaw or nibbler cuts allowed.
- H. All transmitter displays to be in actual unit values and not percent scale.
- I. Door-mounted, rotating operating mechanisms for circuit breakers are not allowed for MCC’s or control panels.
- J. All components inside enclosures shall be fastened down with proper hardware. All cables shall be bundled and bound with waxed cord or nylon tie-wraps manufactured for that purpose. Adhesive tie down blocks are not allowed. Provide threaded press-in or welded studs for nylon cable clamps as required. All work shall be done in a neat and professional manner.
- K. All control panels, SCADA panels and MCC’s shall have 120 VAC GFI duplex receptacles with low voltage circuit inside controls section for test equipment use. Control section shall have interior lighting.

All gauges, instruments, transmitters, and meters to read 75% of scale at system maximum rated parameters such as voltage, amp, pressure, level, and flow.
- L. All controls circuits for PLC’s, Multilins, RTU’s, CCU’s, CCTV, VFD’s, solidstate starters, power monitors and all such products wired into a panel assembled by a panel fabricating shop or system integration shop shall be reviewed and approved by the Product Manufacturer’s Representative. Contractor and Supplier shall allow for any

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additional cost associated with this review and approval process and shall certify such approval has been issued at time shop drawings are submitted.

- M. CT's for power monitor device, controller input or other instrument inputs shall be sized to detect peak inrush current motor.
- N. All electrical devices attached to or, normally a standard part of an equipment item shall be provided by that Equipment Manufacturer. For example, limit switches, solenoids, and transducers for flow control valves are to be provided by the Flow Control Valve Manufacturer. This is to be coordinated by the General Contractor and the Electrical Subcontractor.
- O. All equipment installed on this project shall incorporate all devices and features to protect that equipment from the influence of other equipment, line voltage and phase irregularities, power surges, harmonics and other disturbances that may effect the proper and safe operation of that equipment whether these required features are a standard component of that equipment as an off-the-line product. Provide surge protection devices (SPD) for all power feeders, service equipment and power panels. No equipment shall be installed without these features.
- P. All equipment installed shall include all DC power supplies operated from a 120-volt circuit. No equipment shall be battery powered only unless required by the specifications. Include all cabling and other components necessary for a complete operating system. Where firmware, software, or programming is required for operation satisfactory to Engineer, it shall be included accordingly.
- Q. All equipment and devices shall be NEMA rated. IEC rated equipment and devices are not acceptable.
- R. All requirements for instruments, motor operated valves, VFD's, and electrical equipment shown on electrical plans or described in electrical specifications shall be coordinated through the local Manufacturer's Representative to assure equipment meets the requirements for this project.

All such items shall be purchased through local Distributors or sales offices located within 200 miles of this project. In any case, the local Factory Representative shall be consulted for exact requirements – no exceptions. This is to assure local service for Owner when needed on a 24-hour basis. Any items furnished that do not meet this requirement will be replaced at expense of Contractor.

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- S. All MCC rooms with 800-amp devices and/or MCC's greater than 6 feet wide shall have doors at each end of room unless NEC exceptions apply. Doors shall open in direction of egress and shall have panic bars per NEC Article 110. Egress clearance applies to platform mounted MCC.
- T. All electrical work shall be performed in a neat and orderly manner. Any work that does not appear as professional workmanship shall be corrected or replaced, at Engineers discretion.
- U. All slabs around electrical equipment shall be constructed and sloped to avoid any standing water.
- V. Where equipment model numbers are shown on plans or specifications, provide most current model or version.
- W. Where devices with RS-485 outputs are installed, provide an RS-485 to Ethernet converter with associated power supply.
- X. For rehab or expansion work on controls, provide additional new panduit wireways. Do not overfill Panduit on new or rehab projects.
- Y. All electronic controllers, instruments, and devices furnished by any Vendor or Manufacturer shall have an ethernet data port and means for status monitoring and control interface with the plant PLC controller. Vendor to provide all programs, software, and I/O addresses.
- Z. All service and feeder breakers to be electronic type with adjustable trips.
- AA. All analog instrument outputs to be 4-20 mA unless noted otherwise on Plans. Coordinate scaling with Engineer.
- BB. Provide complete power, control and instrumentation circuits for motor breakers, RTDs, temperature sensors, instruments and control devices.
- CC. All well and blower motor starters to have start time delay relay.
- DD. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions.

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2.03 PLANS AND SPECIFICATIONS

- A. Electrical plans and specifications are not intended to discriminate against any particular manufacturer. Specific values shown for a particular manufacturer's product may vary slightly for another product.
- B. Work required under this contract consists of each and every item, equipment, material and device shown on any of the Civil, Structural, Mechanical, Process, Electrical or other plan sheets contained in the contract documents and includes items shown in details, schedules, diagrams, sections or other means of illustration presented. If any item is shown on a single sheet at any place, it is to be included under this contract unless specifically noted otherwise and, all piping, wiring, and connections for operation of the item shall be included at no additional cost to Owner. If there is any doubt or question, Contractor shall request a "clarification" from Engineer before bidding. The Electrical Engineer reserves the right to interpret the electrical specifications and to make judgment as to acceptance of a product, regardless of minute details in the specifications or on the plans.
- C. Specifications shall be reviewed for applicability of materials under certain conditions and in certain environments and, where not shown otherwise on plan drawings, these application directions shall be adhered to.
- D. Where a particular reference on drawing plans does not conform to standard acceptable construction methods for a particular type project, the Contractor shall immediately notify the Engineer and request a clarification before ordering materials or starting construction.
- E. Plans are general in nature and may not show minute details of existing conditions or proposed work. Existing conditions may include undocumented buried pipes, conduits and structures that lie in the route, or at location, of equipment or conduit installation required for this project. These uncertainties shall be accounted for in the Contractors Bid. Contractor shall adjust conduit routes, equipment pads, and equipment mountings, as required, for a satisfactory installation for the conditions imposed and at no additional cost to the Owner.
- F. Electrical site plan drawings shall only be scaled when "Scalable Drawing" appears on the drawing sheets.
- G. All electrical equipment, controls, and devices used in this project shall have self-protection features that prevent damage of that equipment from overload, overvoltage, undervoltage and phase fail conditions. Any failures caused by lack of this provision

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shall be at full cost to Contractor and equipment manufacturer and at no additional cost to Owner. Where Engineer determines this to be the case and where Contractor disagrees, Contractor shall provide full evidence of failure cause at their own expense.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. All wiring shall be installed in accordance with current NEC and local codes. Field select routing of conduits to avoid underground piping, conduit or structures that may not be shown on plans.
- B. All construction and equipment fabrication shall be of highest quality and installed in a professional manner. All devices shall be manufactured specifically for the purpose installed and shall be installed according to Manufacturer's recommendations.
- C. All fixtures, switch, and receptacle locations shall be approved by Engineer.
- D. Refer to other sections of this specification for controls. Under this section of the specifications, the Contractor shall install the control devices and provide control wiring switches, outlet boxes, and shall make all final connections. Control wiring and interlocks shall conform to wiring diagrams furnished by equipment manufacturers.
- E. Coordinate location of motor terminal box to match location of conduit stub up, drop or connection on same side of motor.
- F. Where equipment, devices, or installation fails or is damaged during construction, said equipment and/or devices shall be replaced with new unit. Repair is not an acceptable remedy unless specifically approved by Engineer and/or Owner.
- G. Provide 48 inches minimum workspace in front of electrical equipment.
- H. Provide a minimum of 8 inches between all wall or rack mounted enclosure boxes, switches, or equipment. Do not extend past edge of building wall and maintain 6 inches from edge of wall.

3.02 ELECTRICAL SYSTEM ACCEPTANCE

- A. System acceptance upon Substantial Completion shall be defined as that point in time when the following requirements have been fulfilled:

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1. When Record drawings and wiring diagrams have been submitted, reviewed, and approved in writing by Engineer.
2. All O&M documentation has been submitted, reviewed, and approved.
3. The complete electrical system has been fully inspected and has successfully been started up, tested and accepted by the Engineer.
 - a. Complete electrical system shall be demonstrated to be fully functional. Every alarm function shall be exercised.
 - b. Complete electrical system shall run continuously for a period of ninety (90) consecutive days without failure. In event of failure, repairs shall be made and test period started over again.
 - c. There are no “Substantial Completions” for electrical systems that cannot demonstrate satisfactory performance of its intended function.
4. All Owners’ staff personnel training programs have been completed.
5. Owner/Engineer sign a document indicating electrical installation has formally been accepted.
6. Warranty certificates for electrical equipment have been properly submitted.
7. All spare parts have been delivered to Owner.
8. All punch list items have been corrected, acknowledged by Contractor in writing and accepted by Engineer.
9. Contractor shall have equipment vendors available for installation, setup, testing, demonstration and commissioning activities as required by other specifications section. Vendors shall allow ample time for these on-site services in their bids.

3.03 CLEAN UP

- A. The Contractor shall upon completion of the work, remove all materials, empty containers, and any other materials that are not incorporated into the work.
- B. Concrete spoils shall not be dumped on site without approval by Engineer or Owner.

3.04 WARRANTY

- A. Contractor shall provide full 3-year service warranty on the overall installation, and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin at date of written final acceptance of electrical systems and shall include both labor and materials at no additional cost to owner. There are no exceptions to this requirement. Contractors warranty shall guarantee 24-hour service response time and shall provide whatever labor, work, or materials needed to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for over 24 hours from time Owner calls for warranty service. This shall be at no additional cost to Owner.
- B. Where circuit problems such as irregular power conditions, breaker trips, relay trips, controls failure, etc. develop during construction or prior to or within the 1 year warranty period, Contractor shall furnish a multi-channel recording device with all appurtenances for a total period of 60 days per event and, shall include setup and data retrieval.

Work shall be performed when requested by Engineer and shall be at no additional cost to Owner. These conditions also apply to electrical problems during construction where operations of the plant are affected.

- C. All materials and equipment installed shall have full warranty from manufacturer that guarantees equipment is rated for the harsh Industrial Electrical/Mechanical environment in which it is installed. Where manufacturer's products fail prematurely, manufacturer shall be fully responsible for new replacement and shall not have option of declaring that failures were caused by environment and its affect on the product. Contractor is fully responsible for assuring that product manufacturers are aware of this condition and that manufacturer's warranty statement is included in shop drawings.

Failure to do so will be at full expense of Contractor and at no additional cost to Owner. Where warranty requirements are shown in other sections, the more stringent requirement shall have precedence.

- D. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within five (5) working days from date of notice are subject to Owner making other arrangements for repair and backcharging Contractor. This requirement is a condition of this contract.

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- E. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

3.05 TRAINING

- A. The Contractor shall provide services of his Technician and a factory trained Technician to instruct plant-operating personnel for a period of at least two (2) full days after completion of the contract work. Training requirements in specific specification sections shall have precedence over requirements of this section.
- B. Where training is required by any specification sections, Contractor shall provide training manuals for Operators. Manuals shall be approved as substantial quality by Engineer. All training manuals must be pre-approved by Engineer. Instructors shall be pre-approved by Engineer as qualified for training. Provide a training manual for each Trainee attending class. Training manuals and approved O&M Manuals shall be used during training.
- C. Provide Engineer with an outline of training course and topics to be covered.
- D. Schedule with Owner two (2) weeks in advance. Where Operators must alternate training schedule, more than two (2) days may be required.
- E. Operations and Maintenance (O&M) manuals and “Record” drawings shall be used during training.
- F. Engineer may participate in training.

3.06 TESTING AND STARTUP

- A. All elements of each electrical control system shall be set up, calibrated, and tested by Manufacturer’s Technician to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer. As a minimum, the testing shall include both a factory test and a field test. Testing requirements are as follows:

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1. Factory Tests: The electrical controls, motor control centers, switchgear, SCADA, instrumentation systems, and all other associated hardware shall be tested via a full simulation at the factory, prior to shipment, to demonstrate that each component is operational and meets the requirements of these specifications. Manufacturer shall provide test routine program for shop simulation of I/O signals where test are unavailable in shop.
- B. Where solid-state controller programs are furnished by a specified Systems Integration Programmer, a copy of the program shall be provided on CD for Manufacturer's use in factory testing. Test results shall be certified, with written documentation provided to the Engineer upon test completion. Factory testing of controls may be witnessed by the Engineer and/or Programmer for all control systems containing a solidstate controller of any type.
- C. Field Tests: All electrical control system components and instruments shall be checked to verify that they have been installed properly, all terminations have been made correctly and signal parameters are accurate. This includes demonstration of accuracy or all instruments over entire range of operation by live simulation of measurement. Electronic simulation above is not acceptable.
- D. Witnessed field tests shall be performed on the complete system. Prior to witnessed test, Contractor shall perform a complete test of each and every function, device operation and overall operations of electrical power, control, instrumentation and SCADA system.
- E. Prior to loading PLC or SCADA final program and prior to testing operation any PLC or SCADA set up by Programmer, an inspection shall be conducted by Engineer's Inspector to assure electrical control devices are functioning properly. Any discrepancies or problems shall be corrected and then Contractor shall send a written notice that complete electrical control system is installed and operating per the Plans and Specifications.
- F. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a paragraph-by-paragraph basis. Any equipment, devices or functions that are found not performing properly will be reason for termination of test until repairs are made. Additional testing by Engineer and Owner may be at Contractor's expense for time and travel of Engineer and Owner's staff. Each test shall be witnessed and signed off by the Contractor and the Engineer upon satisfactory completion. The equipment Manufacturer's Representative shall be present for all testing, setup, demonstrations, and training. The Contractor shall notify the Owner at least

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two (2) weeks prior to the commencement date of the field tests. After tests are completed and with system fully operational, system shall run continuously for a period of 90 days without failure. Any failures shall be repaired and test shall start over again.

1. Additional Requirements:
 - i. Measure and record all motor in-rush, run current and terminal voltage at start and run testing. Where multiple motors are installed, test shall include all motor sequencing smallest to largest. Submit recorded values for Engineer's review. Provide instrument and electronic devices calibration ranges and scales for this specific project. (Manufacturer's general information is not sufficient. Include range of 4-20 mA signals, i.e., 4 mA = X psi or Y feet, etc. for each specific instrument and device.)
 - ii. Provide setting and adjustments of all solid-state and non-solid-state starters, circuit breakers, controllers, instruments, and other equipment with adjustable settings both manual and programmable. Submit for Engineer's review and approval before operating equipment.
- G. Provide statement of satisfactory demonstration of all instruments, devices and equipment functions over full range of operation. (Any failures or incorrect calibrations or settings detected shall be reason to halt demonstration tests and reschedule after adjustments and recalibrations have been completed.)
- H. Factory Technician report stating that all calibrations, settings and adjustments have been completed and that equipment has been functionally tested by Factory Technician on site. (Where report is found to be inaccurate, the Technician shall make necessary on site adjustments and shall issue new report, and where second report is required, a Factory Manager shall sign report attesting to its accuracy. There is no exception to this requirement. Contractor shall be responsible for all factory set up, testing and demonstration costs until system is accepted by the Engineer. Any additional testing as result of non-acceptance by Engineer shall be at Contractor's expense.
- I. Record Drawings (Point to point wiring diagrams for every electrical device installed on this project with tags and applicable schedules shall be available at time of testing. Lack of this requirement will result in cancellation of testing until complete documentation is available. This will allow checking of wiring accuracy at time of testing.)
- J. A state licensed Electrician shall supervise all testing and scheduled inspections.

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- K. Controller Program: Remote testing by Engineer will require a minimum of 30 working days after programs are downloaded to the controller. Provide six (6) weeks' notice for program downloading by Programmer. This shall be accounted for in project schedule. Any delay of project completion due to lack of notice is at Contractor's risk and expense.
- L. Prior to testing system, PLC programs or HMI programs provided by other than the Systems Integration Engineer noted in Item 1.07 – "Contractor's Responsibilities", programs shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program.
- M. Modem setup shall be conducted by Manufacturer's Technician before any field-testing by Engineer is performed. Set up per Manufacturer's written instructions. Provide Engineer with checklist and values of all settings and adjustments before requesting field test by Engineer. Indicate impedance of terminal load resistor at each end of modem line.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

SECTION 16013

ELECTRICAL SUBMITTALS

PART 1 GENERAL

1.00 GENERAL REQUIREMENTS

- A. Requirements described by this section are in addition to any requirements of the General Conditions of the project. The electrical engineer requires electronic submittals for all equipment provided under the electrical and controls specifications. Do not submit hardcopies to the electrical engineer. This does not eliminate any requirements for hardcopies required by the Owner as required by the General Conditions.
- B. Requirements of this section apply to all other electrical instrumentation and control related specifications for this project. Submittals provided without all required information are subject to be rejected without review.
- C. Contractor is to provide a schedule that at minimum shows estimated start dates, completion dates, shop test dates, and field test dates. It is the contractor's responsibility to provide updated schedules to our office in a timely manner.
- D. Contractor is required to provide the electrical submittal log with electrical or controls submittals.
- E. Contractor is fully responsible for coordinating/submitting correct operating voltage, horsepower, current, phase and starter sizes requirements of all equipment furnished and installed under this contract. Shop drawing review by Engineer does not remove this responsibility. Manufacturer's light fixture and accessories data sheets shall not confirm reference to "Contractor Select". Data sheets shall have model numbers that correctly identifies fixture and accessories as described and included on plans and in specifications. Incorrect submittal information is at risk of Contractor and at no additional cost to Owner.
- F. Submittals of motor control and electronic device shop drawings will require a minimum of two (2) weeks for review from time of receipt by Electrical Engineer. Contractor shall submit all shop drawings in time to account for this period of review.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

- G. All submittals for motor control centers, control panels, control sections, controllers, lift pump panels, and Vendor furnished panels must contain statement of U.L. certification and identifying name and number of U.L. certification for fabricating shop.

All submittals without this information will be rejected. Any MCC's or panels installed without U.L. listing and where not acceptable by Engineer or Owner will be replaced at cost of Contractor.

- H. Where submittals for a particular equipment, device or material item vary from that specified or shown on plan drawings, and where that item is not specifically noted as acceptable and, where installation of submitted item results in improper or undesirable operation of the system, Contractor shall be liable for removal and/or replacement of that item with the item specified or shown on plan drawings at no additional cost to Owner. Such items submitted as substitutions shall be listed separately and clearly noted as "Substituted Item". Do not include Manufacturer's catalog data pages that do not apply to specific equipment or devices used for this project.
- I. General Contractor shall route all Vendor submittals with electrical requirements to Electrical Contractor who shall review and coordinate all power and control requirements and affix stamp certifying coordination. Any variation to plans or specifications shall be noted accordingly on Vendor's submittal.
- J. All equipment shop drawings shall indicate changes or modifications as a result of previous submittal variances. No shop drawings shall be submitted that have not been coordinated as required by this specification. Any submittals not coordinated as such will be at Contractor's risk and at no additional cost to Owner for required changes necessary for a complete operating system as intended by the plans and specifications for this project.
- K. Provide detailed drawings of equipment, MCC's, transformers, and control panel layout in room or on area plan drawing. Show dimensions of device layouts on control panels. Show room or area dimensions, conduit stub-up locations, and all other dimensions relative to placement of equipment. All equipment shall fit available space shown on plans. Provide detailed drawings of any modifications, concrete cutting or breaking, or any work not shown on drawings for Engineer's approval. Non-submittal of any such work will result in corrective action at Contractor's expense. Special fabrication may be required for MCC's, control panels and other equipment. Note any exceptions or variations in size, location or configuration on submittal.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

Do not order equipment, MCC's, or panels until submittal has been approved by Engineer in writing. Where outdoor light poles and pull boxes are installed, provide dimensioned location layout submittal before starting work.

- L. Provide detailed sketch of all unistrut racks and other type mounting assemblies for Engineer's review before starting work. Items not submitted and not determined as acceptable after construction shall be replaced at no additional cost to Owner.
- M. Any notifications or changes to contract plans and specifications shall be authorized by Engineer before submitting shop drawings for approval.
- N. With each submittal, include an electronic copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.01 SUBMITTAL REQUIREMENTS

- A. Contractor is to submit all shop drawings, and product data required per the relevant specifications section at one time. All related submittals are to be submitted at one time.
- B. Contractor to follow a consistent naming convention such as:
 - 1. Submittal Number – Submittal Name – Revision Number.File Extension
 - i. ##-Submittal Title-Rev #.PDF
- C. Submittals are to be formatted as a single PDF format with a table of contents. Submittals that are provided as a group of PDF files not formatted as described will be rejected.
- D. The following information must be provided with each submittal:
 - 1. Date and Revisions Dates
 - 2. Project Title matching plans and specifications
 - 3. Prime Engineer's Project Number
 - 4. Electrical Engineer's Project Number
 - 5. Name of Project Manager, Address and Telephone Numbers of:

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

- i. General Contractor
- ii. Electrical Contractor
- iii. Vendor
- iv. Manufacturer
- 6. Specification Section Number
- 7. Submittal Log
- 8. List of Deviations and Reasons
- 9. Specifications Compliance Checklist
- 10. General Contractor Signature

1.02 SUBMITTAL LOG (Water Plant)

Item No.	Submittal Description	Related Electrical Specification Sections	Submitted
1.	Construction Schedule	16012	
2.	Well Pump and Motor	16150	
3.	Booster Pumps	16150	
4.	Automatic Transfer Switch	16496	
5.	Manual Transfer Switch	16494	
6.	Generator	15249, 16650, 16660, 16661, 16622, 16655, 16497	
7.	Autosensory Panel	16012, 16016, 16195, 16904, 16935, 16936, 16950	
8.	Motor Control Center	16124, 16125, 16176, 16290, 16410, 16452, 16460, 16470, 16481, 16482, 16484, 16496,	

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

		16911, 16662	
9.	Site, Control Room and Generator Pad Layouts	03301, 16012, 16401, 16740	
10.	Electrical Service Equipment	03400, 16012, 16290, 16476, 16494, 16030	
11.	Misc. Electrical Equipment <i>(Include conduit, conductors, lighting, HVAC, transformers, panelboards, disconnects, grounding, and other appurtenances)</i>	16012, 16030, 16111, 16119, 16120, 16122, 16133, 16125, 16126, 16402, 16452, 16450, 16460, 16470, 16476, 16477, 16510, 16515, 16525, 16989, 16937, 16640, as indicated on electrical plans	
12.	Chemical Feed Equipment	As indicated on electrical plans	
13.	Flow Meter(s)	13418, 13420, 13426, 13427	
14.	Flow Control Valve(s)	As indicated on electrical plans	
15.	O&M Manuals	16012	
16.	As-Built Drawings	16012	

Notes:

1. Submittal log to be included with each submittal. Check off all submittals previously submitted in the far right column.
2. Submittals may be combined.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

CONTRACTOR SUBMITTAL LOG *(Lift Station)*

Item No.	Submittal Description	Related Electrical Specification Sections	Submitted
1.	Construction Schedule	16012	
2.	Lift Pump & Accessories	As indicated on electrical plans	
3.	Generator and Automatic Transfer switch	16496, 16622 16650, 16655, 16660	
4.	Control Panel	13471, 16012, 16016, 16176, 16195, 16290, 16460, 16470, 16481, 16904, 16911, 16935, 16936	
5.	Site and Generator Pad Layouts	03301, 16012, 16401, 16740	
6.	Electrical Service Rack Equipment	03400, 16012, 16290, 16476, 16494	
7.	Misc. Electrical Equipment <i>(Include conduit, conductors, lighting, grounding, and other appurtenances)</i>	16111, 16120, 16125, 16126, 16131, 16135, 16402, 16452	
8.	Flow Meter(s)	13418	
9.	O&M Manuals	16012, various specification sections	
10.	As-Built Drawings	16012	

Notes:

1. Submittal log to be included with each submittal. Check off all submittals previously submitted in the far right column.
2. Submittals may be combined.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

CONTRACTOR SUBMITTAL LOG (WWTP)

Item No.	Submittal Description	Related Electrical Specification Sections	Submitted
1.	Construction Schedule	16012	
2.	Blower(s)	16016, 16150, 16936	
3.	Clarifier(s)	16016, 16150, 16936	
4.	Headworks Package	16016, 16150, 16936	
5.	Scum Pump Package	16016, 16150, 16936	
6.	NPW System Pump Skid	16016, 16150, 16936	
7.	Disk Filter Package	16016, 16150, 16936	
8.	Automatic Transfer Switch	16496	
9.	Manual Transfer Switch	16494	
10.	Generator	15249, 16650, 16660, 16622, 16655	
11.	Autosensory Panel	16012, 16016, 16195, 16904, 16935, 16936	
12.	Motor Control Center	16176, 16290, 16410, 16452, 16460, 16470, 16481, 16482, 16484, 16496, 16911	
13.	Site, Control Room and Generator Pad Layouts	03301, 16012, 16401	
14.	Electrical Service Equipment	03400, 16012, 16290, 16476, 16494	
15.	Misc. Electrical Equipment (Include conduit, conductors, lighting, HVAC, transformers, panelboards, disconnects, grounding, and other appurtenances)	16012, 16111, 16120, 16125, 16126, 16402, 16452, 16460, 16470, 16476, 16510, 16515, 16525, as indicated on electrical plans	

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL SUBMITTALS

16.	Chemical Feed Equipment	As indicated on electrical plans
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17.	Flow Meter(s)	13418, 13624
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18.	O&M Manuals	16012
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19.	As-Built Drawings	16012
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Notes:

1. Submittal log to be included with each submittal. Check off all submittals previously submitted in the far right column.
2. Submittals may be combined.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL OPERATION & MAINTENANCE (O&M) MANUAL

SECTION 16014

ELECTRICAL OPERATION & MAINTENANCE (O&M) MANUAL

PART 1 GENERAL

1.00 GENERAL REQUIREMENTS

- A. Requirements described by this section are in addition to any requirements of the General Conditions of the project. The electrical engineer requires electronic submittals for all equipment provided under the electrical and controls specifications. Do not submit hardcopies to the Electrical Engineer. This does not eliminate any requirements for hardcopies required by the Owner as required by the General Conditions.
- B. Any hardcopies provided to Owner after approval by Electrical Engineer are to be professionally assembled with tabs and coversheets.
 - 1. Wiring diagrams shall be on same size pages (8.5x11 or 11x17 pullout sheets) as used in Operations and Maintenance Manuals and shall be placed in a separate section of the Manuals identified as Wiring Diagrams.
 - 2. Each O&M Manual hard copy shall include a CD that contains the complete, organized O&M Manual in PDF format inserted in a pocket near front of Manual. All O&M Manuals shall be professionally written and bound in high quality latching post vinyl binder. Loose page three ring binders are not allowed.
- C. Requirements of this section apply to all other electrical instrumentation and control related specifications for this project. Submittals provided without all required information are subject to be rejected without review.
- D. Provide diagrams of all controls panels and MCC's in clear plastic laminated pages. One (1) copy in ring binder for Operator and one (1) copy in pocket affixed to inside of cabinet door.
- E. Contractor is to provide submittals in accordance with 16013 Electrical Submittals.

1.01 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Contractor is to submit all shop drawings, and product data required per the relevant specifications section at one time. All related submittals are to be submitted at one time.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL OPERATION & MAINTENANCE (O&M) MANUAL

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1. The contents of the O&M manuals shall be generally organized as follows:
 2. Contact Information for all contractors and vendors
 3. System Hardware/Installation
 4. System Software (where applicable)
 5. Operation (step-by-step procedures)
 6. Electrical and Control Wiring Diagrams
 7. Maintenance and Troubleshooting
 8. Warranty Certificates
 9. Point-to-Point Wiring Diagrams for each circuit installed or provided by equipment suppliers.
 10. Device Information
 - a. Instrument and electronic devices calibration ranges and scales for this specific project. (Manufacturer's general information is not sufficient. Include range of 4-20 mA signals, i.e., 4 mA = X psi or Y feet, etc. for each specific instrument and device.)
 - b. Setting and adjustments of all solid-state and non-solid-state starters, SCADA, PLC's, circuit breakers, controllers, instruments, and other equipment and devices with adjustable settings both manual and programmable settings. Provide this information in table format and show current settings of each adjustable device for this installation, in each motor control center section and each control panel.
 - c. Statement of satisfactory demonstration of all instruments, devices and equipment functions over full range of operation. (Any failures or incorrect calibrations or settings detected shall be reason to halt demonstration tests and reschedule after adjustments and recalibrations have been completed.)

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRICAL OPERATION & MAINTENANCE (O&M) MANUAL

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- d. Factory Technician report stating that all calibrations, settings and adjustments have been completed and that equipment has been functionally tested by Factory Technician on site. Where report is found to be inaccurate, the Technician shall make necessary on site adjustments and shall issue new report, and where second report is required, a Factory Manager shall sign report attesting to its accuracy. There is no exception to this requirement. Contractor shall be responsible for all factory set up, testing and demonstration costs until system is accepted by the Design Engineer. Any additional testing as result of non-acceptance by Engineer shall be at Contractor's expense.

1.02 RECORD DRAWINGS

- A. The Contractor is required to keep up to date redlines at all times and may be reviewed during construction at any time by the Engineer. Record Drawings that are found to be inaccurate are the responsibility of the Contractor.
- B. Record Drawing Drawings to include point-to-point wiring diagrams for every electrical device installed on this project.
- C. Provide Record Drawing that clearly show any work that varies from the Contract Drawings. Remove any lines or text from drawings that no longer apply as a result of as-installed variations. "Record Drawing" Drawings shall be on backgrounds that are furnished by the Engineer. All changes are to be in latest version of AutoCAD or other applicable CAD methods as required by Owner or Engineer. Contact Engineer for CAD standards to be followed. Submit Record Drawing Drawings electronically for review.
- D. All underground conduits entering any building under or in slab shall be accurately dimensioned as to location. Show accurate dimensioned layout of conduits under or encased in building slabs. Record Drawing mark-ups shall be submitted to Engineer for review and coordination prior to cover up with slab or backfill.
- E. Show accurate dimensioned location of all conduits and ductbanks on site and on structures that are installed or modified under this contract. Identify conduits by tag number.
- F. Show location and identify all new or relocated devices and equipment in rooms and on structures.

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ELECTRICAL OPERATION & MAINTENANCE (O&M) MANUAL

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- G. Provide accurate and complete point-to-point wiring diagrams for all power, control and instrument circuits. Identify each conductor, conduit, terminal block, and device terminal. Use manufactures device terminal numbers and do not assign new conflicting termination numbers. Quality and content of diagrams and drawings shall be such that future troubleshooting or modifications may be done without additional information from field observations. Contractor will be asked to demonstrate certain circuits selected by Engineer or Owner to assure accuracy and completeness of diagrams. Any errors shall be corrected before acceptance of work. This work includes every circuit installed or modified under this contract, without exception.
- H. Record Drawing construction drawings shall be provided on full size plan sheets for Owner and furnished electronically in AutoCAD format for Owner and Electrical Engineers files. Provide hard copy quantities specified in this specification or in General Conditions Specifications, whichever is more stringent.

END OF SECTION

SECTION 16111

CONDUIT, FITTINGS, AND BODIES

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SECTION INCLUDES

- A. Specification for conduit, fittings, and bodies.

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
 - 1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated.
 - 2. ANSI C80.4: Fittings for Rigid Metal Conduit.
- B. Federal Specifications.
 - 1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum, and Malleable Iron.
 - 2. W-C-1094A: Conduit and Conduit Fittings Plastic, Rigid.
 - 3. WW-C-566C: Flexible Metal Conduit.
 - 4. WW-C-581E: Coatings on Steel Conduit.
- C. National Electrical Manufacturers Association (NEMA).
 - 1. NEMA RN1: Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
 - 2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

- 3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC).
- E. Underwriters' Laboratories (UL).
 - 1. UL 1: Flexible Metal Electrical Conduit.
 - 2. UL 6: Rigid Metal Electrical Conduit.
 - 3. UL 514B: Fittings for Conduit and Outlet Boxes.
 - 4. UL 651: Schedule 40 and 80 Rigid PVC Conduit.
 - 5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - 6. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.
- F. Section 16195 – “Electrical Identification”

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer’s approval.
 - 1. Manufacturer's cut sheets, catalog data, with selected products clearly marked.
 - 2. Installation, terminating and splicing procedure.
 - 3. Instruction for handling and storage.
 - 4. Dimensions and weight.
- B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

- A. Tests:

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CONDUIT, FITTINGS, AND BODIES

1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1.
2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.
3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A.

1.05 DELIVERY STORAGE AND HANDLING

- A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.
- B. Store conduit above ground on racks to prevent corrosion and entrance of debris.
- C. Protect plastic conduit from sunlight.

PART 2 PRODUCTS

2.00 ACCEPTABLE MANUFACTURERS

- A. Rigid Steel Conduit.
 1. Allied Tube and Conduit
 2. Western Tube and Conduit
 3. Wheatland Tube Company
- B. PVC Coated Steel Conduit.
 1. Occidental Coating Company (O-Cal)
 2. Robroy Industries, Inc. (Plasti-Bond, KorKap, or Perma-Cote)
 3. NEC, Inc. (BlackGuard)
- C. PVC Rigid Conduit.

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CONDUIT, FITTINGS, AND BODIES

1. Cantex
2. Carlon Industries, Inc.
3. Robroy Industries, Inc.

D. Conduit Fittings and Bodies.

1. Appleton Electric
2. Crouse-Hinds
3. Killark Electric Manufacturing Company
4. O-Z/Gedney

E. Liquidtight Flexible Conduit.

1. Anamet, Inc.
2. Electriflex Company
3. Triangle Wire and Cable, Inc.

F. Aluminum Conduit:

1. Allied Tube and Conduit
2. Indalex
3. Or equal

2.01 MATERIALS AND EQUIPMENT

A. Design Conditions. Use electrical conduit, fittings, and bodies designed for service in areas as specified within this section to form a continuous support system for power, control, and instrument cables.

1. Use PVC coated steel conduits and hardware for Wastewater Facilities or corrosive environments.
2. Use rigid galvanized steel conduits for Water Facilities.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

B. Conduit and Fittings

1. Rigid Steel Conduit and Fittings:

- a. Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581E, and NEC Article 344.
- b. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.
- c. Fittings, bodies, and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C.

2. PVC-Coated Rigid Steel Conduit and Fittings.

- a. PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN1 (Type A). Rigid steel galvanized conduit and fittings before coating shall conform to Federal Specification WW-C-581E, ANSI C80.1, and UL 6. Conduit bodies shall conform to UL 514B and Federal Specification W-C-58C. Provide sufficient coating for touch up after installation.
- b. PVC-coated couplings shall be of the ribbed type for sizes ½”-4”.
- c. Condulet covers shall have encapsulated stainless steel thumbscrews.
- d. Condulets and covers shall be of malleable iron or ferrous material before coating.
- e. Urethane coating shall be a minimum of 2-mil thickness on the interior of the conduit and the interior of fittings, condulets, covers, and bodies.
- f. Conduit clamps, unistrut, and devices shall be PVC coated when used with PVC-coated conduit.

3. Flexible and Liquidtight Flexible Metal Conduit and Fittings.

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CONDUIT, FITTINGS, AND BODIES

- a. Use liquidtight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C.
 - b. Fittings used with liquidtight flexible metal conduit shall be the PVC- coated type and of such design as to thoroughly ground the conduit to the fittings and through it to the box or enclosure to which it is attached.
 - c. Liquidtight flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-10 (A&B), and Federal Specification W-C-586C.
 - d. Do not use flexible metal conduit or liquidtight flexible metal conduit for light fixtures or receptacles unless shown on plans or approved by Engineer.
4. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-1094A, and NEC Article 352-III for above ground and underground installation. Conduit shall be Schedule 80, unless shown or noted otherwise on drawings or in other specifications.
5. Use PVC Schedule 80 conduits, fittings, and boxes for all chemical areas and provide conduit seals per NEC.
6. Aluminum RMC conduit may be used only where shown on plans.
7. Do not use liquid tight flexible metallic conduit to connect rigid conduit to fixed or wall mounted enclosures or panels.
8. Do not run liquid tight flexible metallic conduit directly thru walls, ceilings, or floors.
9. Do not attach liquid tight flexible metallic conduit with nylon or plastic tie-wraps on straps. Use aluminum straps made for that purpose, except where approved by Engineer.

PART 3 EXECUTION

3.00 PREPARATION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

- A. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types, and routing shown.
- B. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.
- C. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.
- D. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.
- E. Submit layout of all conduit stub-ups for Engineers review before installing conduits. Do not install conduit to equipment, electrical panels or devices until enclosure locations and sizes have been determined and verified by Supplier.

3.01 INSTALLATION

- A. Install PVC-coated conduits in all locations at wastewater facilities, inside valve vaults, in wet well slabs, in corrosive and wet environments, in chemical rooms (Schedule 80 required) and, where specifically noted on drawings. Aluminum PVC-coated conduit may be used where specifically shown on plans, where specifically noted in specifications or where approved in writing. Install PVC coated conduits in Water Facilities where wet locations, inside valve vaults, or where specifically shown on Plans or noted in other Specifications.
- B. Install rigid galvanized steel (RGS) conduits in dry inside locations and in all outdoor locations for water facilities and, where specifically noted otherwise on drawings. Aluminum RMC may be used where specifically shown on plans, where specifically noted in specifications or where approved in writing. Where aluminum conduit is approved, use all aluminum condulets and fittings.
- C. Install PVC conduits in duct banks. For stub-ups and directional turn elbows, use PVC-coated rigid steel elbows or rigid steel elbows as applicable in A and B above and other specifically noted locations on drawings. Rigid steel stub-up shall have minimum three (3) layers of mylar tape up to 1" above slab where conduit is in contact with concrete. Stub-ups inside MCC's, panels, equipment and/or enclosures shall have threads with grounding bushings installed.
- D. Stub up all conduits entering MCC's, and other equipment enclosures from the bottom into each respective starter, feeder breaker or control section per equipment manufacturers

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CONDUIT, FITTINGS, AND BODIES

conduit layout detail. Coordinate with equipment manufacture data sheets before starting any underground or below slab conduit installations.

- E. Run exposed conduit parallel or perpendicular to walls, ceilings, or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'-0" in passageways. Except where absolutely impossible, all conduits are to be installed in or under concrete slab, in walls and ceilings. Any exposed conduit installed otherwise may be relocated at Contractor's expense where directed by Engineer or Owner. Exceptions, where specifically noted otherwise on plans. **Do not route conduits across walk-ways or egress paths.**
- F. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed.
- G. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes. Tag all conduits per Section 16195 – "Electrical Identification," Item 2.01 – "Raceway and Cable Labels."
- H. Not more than three (3) equivalent 90 degree bends will be permitted between pullboxes, or between pullboxes and equipment. Provide bonded expansion fittings at building expansion joints. Where pullboxes are located such the three 90 degree bend rule is not exceeded without the pullbox, the box may be deleted where approved by Engineer in writing.
- I. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight.
- J. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the

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threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials.

- K. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks.
- L. Make up changes in direction of exposed conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise. Do not use elbow bends for change in direction of exposed conduit.
- M. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.
- N. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign matter into the conduit system by properly capping terminations.
- O. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" conduit equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.
- P. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.
- Q. Where conduit terminates in sheet metal enclosures, threaded hubs are required. Conduit entries with double locknuts and bushings are prohibited. Sheet metal enclosures located outside or in any other wet, damp, or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure.
- R. Provide liquid tight flexible metallic conduit only where necessary to allow for movement or to localize sound or vibration, at transformers, at motors, solenoid valves, motor

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operated valves, generators, and any other rotating equipment unless shown otherwise on Drawings. Limit length to less than 2 feet. Do not make rigid connections of conduit to vibrating equipment housing or frame. Do not use flexible metallic conduit for light fixture circuits or similar devices and do not use as a substitute for rigid conduit.

- S. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the Drawings. Certain walls, where indicated on the Drawings, require environmental (airtight) seals; seal as shown.
- T. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area, where shown on Drawings. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well. Install EYS seals in all conduits leaving chemical rooms or chemical storage spaces. There shall be no unions, couplings, boxes, or fittings in conduit run between seal and point at which conduit leaves the room.
- U. Unless otherwise indicated on the Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.
- V. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4 inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.
- W. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.
- X. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.
- Y. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment.

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Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met.

- Z. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit.
- AA. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet.
- BB. The means of fastening conduit to supports shall be: by one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.
- CC. Support conduit runs with conduit clamps, hangers, straps, and metal framing channel attached to structural steel members. Conduits of 1-1/2 inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be Type 316 stainless steel.
- DD. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit. All conduits shall be routed below concrete floor slabs on grade and shall have sand fill and cover. Set depth to account for radius of turn-up to prevent exposure of elbow bend.
- EE. Where specifically shown on plans, size and space embedded conduits in structural slabs in accordance with the Uniform Building Code. Conduits should occupy no more than one-third the thickness of the slab and should not be closer than 3 times the largest diameter on center without additional reinforcement.
- FF. Do not cut paved driveways, sidewalks, concrete foundations, etc. to install conduits unless specifically noted on plans. Bore under such construction and maintain a minimum of 24 inches below underside of paving or concrete. Repair any cutting or damage to original condition and to satisfaction of Engineer and Owner.
- GG. All conduits for fiber optic cables are to have wide tube radius compatible with cable manufacturer's requirements. Install per NEC.

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- HH. Damaged conduits shall be replaced at no additional cost to Owner where Engineer deems necessary because of extent of damage or, where conductors are damaged by defective conduit installation.
- II. Seal all conduits entering motor control centers, control panels, equipment, enclosures, valve actuators, etc. with CSBE seals or, install EYS at locations permissible. Sealing glands shall be selected specifically for each conduit and conductor. Install seals at all equipment located at elevation lower than U.G. conduit route.
- JJ. Conduits penetrating underground pull boxes shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon based sealant where smaller than 1 ¼-inch diameter.
- KK. Conduits penetrating structural walls of lower levels shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon based sealant where smaller than 1 ¼-inch diameter. Duct seal is not allowed.
- LL. All conduit duct banks penetrating lower level structures and penetrating underground pull boxes shall be sealed watertight between conduit and wall of structure or pull box.
- MM. Where conduits are stubbed out from building for future use, extend conduits 5 feet past building wall or past edge of pavement, whichever is applicable. Do not leave under pavement. Cap ends of conduits.
- NN. All conduits shown entering outside walls of buildings may stub-up immediately adjacent to wall and penetrate low on wall where specifically indicated on plans. Where not shown entering wall, all conduits shall be routed up through building floor by excavating below foundation, core drill through floor, and stub-up conduits then backfill with cement stabilized sand, compacted in place.
- OO. Apply a conductive coating to field-cut threads of aluminum conduits to ensure continuity and ease of joining. Noalox and Kopr-Shield are acceptable coatings.
- PP. Avoid excessive force when tightening threaded fittings for aluminum conduit, both between conduits and at threaded box entries. Generally, the correct force is hand-tight plus one full turn with a wrench. At least three (3) full threads should be engaged.
- QQ. Do not use conduit bushings to secure threaded aluminum RMC to a box or enclosure. Install a locknut between a conduit bushing and the inside of the box or enclosure.
- RR. Threadless fittings shall not be used with threaded aluminum conduit.

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- SS. Install expansion fittings in outdoor runs of aluminum RMC.
- TT. Do not install aluminum conduit in concrete or underground.
- UU. Use special tools for installing aluminum conduit. All damaged conduits shall be replaced.
- VV. In chemical rooms, enclosures, and portable/prefab buildings used for chemical storage or chemical equipment operation, use Schedule 80 PVC conduit and fittings only, except where specifically noted on Plans, use PVC coated steel conduit. Use PVC boxes and enclosures. There are no exceptions to this requirement unless specifically noted on drawings as an exception to this section.
- WW. Provide minimum one (1) additional spare 2 inch, two (2) spare 1 inch conduits from MCC to U.G. pull box and between all U.G. pull boxes on site.
- XX. Do not route conduit on outside walls of buildings or structures unless specifically shown on Plans, route from floor slab. Do not route conduit on building interiors, MCC rooms or equipment rooms unless shown on Plans, or approved in writing. Exception: conduits to light fixtures on ceilings. Paint to match. Where shown on Plans or where approved, conduits shall be painted to match surface on which installed. Submit drawings or sketches of any conduit routing that varies from Plans or Specifications.
- YY. Where underground conduit ductbanks are routed under new building slabs greater than 4 inches thick, conduits may be encased in cement stabilized sand with red marking tape.
- ZZ. Provide steel conduit for all security, fire, TV, and access control system circuits. Coordinate circuits and conduit requirements within respective vendors.
- AAA. Paint all exposed conduit threads to prevent corrosion. Match color of conduit.
- BBB. Paint all exposed rigid steel surface mounted conduits in MCC rooms. Match wall and ceiling color.
- CCC. Do not route conduits across slabs. Route below slab and turn up at proper location. For existing structures, excavate beneath slab, core drill for conduit penetration up to equipment and back fill excavation with cement-stabilized sand. See details on plans for installation methods.
- DDD. Contact Engineer for inspection of conduit stub-ups and U.G. ductbanks before concrete pour.

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- EEE. Where RGS conduit is installed on interior or exterior building walls (or ceilings), paint conduit, supports and clamps to match wall color.
- FFF. For conduits that will contain coaxial cable or other wide radius band cables, provide wide sweep conduit elbows on bends that will accommodate pulling such cables thru 3 90 degree turns without exceeding bends radius limitations.

END OF SECTION

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UNDERGROUND DUCTS AND MANHOLES

SECTION 16119

UNDERGROUND DUCTS AND MANHOLES

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 – “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SUMMARY

- A. Section Includes:
 - 1. Ducts.
 - 2. Duct banks.
 - 3. Manholes.
 - 4. Handholes.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. C2-93 - National Electrical Safety Code.
- B. American Society for Testing and Materials (ASTM):
 - 1. C478 REV B-90 - Standard Specification for Pre-cast Reinforced Concrete Manhole Sections.
 - 2. C891-90 - Standard Practice for Installation of Underground Pre-cast Concrete Utility Structures.
- C. National Electrical Code – Article 110, Section V – Manholes and other Electric Enclosures Intended for Personnel Entry – All Voltages.

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1.03 DEFINITIONS

- A. Duct: General term for electrical conduit and other raceway, either metallic or nonmetallic, specified for use underground, embedded in earth or concrete.
- B. Duct Bank: Group of two or more ducts in continuous run between two points.
- C. Underfloor Conduits.
 - 1. Conduits, which run underground within perimeter of building walls under building floor. This may consist of one conduit, or several conduits grouped together.
- D. Duct Bank Conduits
 - 1. Conduits, which run under ground outside perimeter of building walls, may consist of one conduit, or several conduits grouped together.
- E. Underground Conduits
 - 1. Underground conduits are both underfloor conduits and duct bank conduits.
- F. Handhole: Below-the-surface enclosure in connection with ducts into which people reach, but do not enter, for purpose of installing, operating, or maintaining equipment or wiring.
- G. Manhole: Below-the-surface enclosure or chamber, large enough for a person to enter, connecting with ducts, and affording facilities for installing, operating, and maintaining equipment or wiring.

1.04 SUBMITTALS

- A. Submit all products covered under this specification for Engineer's approval.
- B. Submittals are not required if Contractor supplies materials or equipment of specified or named manufacturers. If Contractor proposes substitutions to material or equipment of specified or named manufacturers, submittals identified below are required.
 - 1. Product data.
- C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the

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applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturers of pre-cast manholes and handholes shall be firms regularly engaged in manufacturing factory-fabricated manholes and handholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 yrs.
- B. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 - 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 - 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- C. Regulatory Requirements:
 - 1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
 - 2. All manholes to be sized in accordance with NEC Article 370-28.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store pre-cast concrete units at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- B. Lift and support pre-cast concrete units only at designated lifting or supporting points.

1.07 SEQUENCING AND SCHEDULING

- A. Coordination of Work:
 - 1. Coordinate layout and installation of manholes and handholes with final arrangement of ducts as influenced by actual final location of other utilities in field.
 - 2. Coordinate elevations of duct and raceway entrances into manholes and handholes with final profiles of ducts and raceways as determined by coordination with other utilities, underground obstructions, and buildings.

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3. Establish locations and elevations to suit field conditions and assure duct banks run drain to manholes, handholes, or as shown on Drawings.

PART 2 PRODUCTS

2.01 DUCTS AND FITTINGS

- A. Conform to Raceways, Section 16110 – “Raceways.”

2.02 CAST-IN-PLACE CONCRETE

- A. Aggregate For Duct Encasement: 3/8-in. maximum size.
- B. Strength: 3,000-psi minimum 28-day compressive strength.

2.03 DUCT BANK ACCESSORIES

- A. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacings and concrete cover depths indicated, while rigidly supporting ducts during concreting.

2.04 MANHOLE/HANDHOLE HARDWARE AND ACCESSORIES

- A. Frames and Covers: Cast iron conforming to ANSI C2, Rule 323. Furnish with cast-in legend, "Electric" or "Signal" as appropriate. Cover-to-frame bearing surfaces machined.
- B. Sump Frame and Grate: Comply with FS RR-F-621, Type VII for frame, Type I for cover.
- C. Pulling Eyes in Walls: Eyebolt with rebar fastening insert. 2-in. dia eye, 1-in. by 4-in. long bolt. Working load embedded in 6-in, 4,000 psi concrete: 13,000 lbs minimum tension.
- D. Pulling and Lifting Irons in Floor: 7/8-in. dia hot-dipped galvanized, bent steel rod, stress relieved after forming, and fastened to reinforced rod. Exposed triangular shaped opening. Ultimate yield strength, 40,000 lbs shear, 60,000 lbs tension.
- E. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of non-corrosive, chemical resistant, nonconductive thermoplastic material. 1/2-in. internal dia by 2-3/4 in. deep, flared to 1-1/4-in. minimum at base. Tested ultimate pull-out strength: 12,000 lbs, minimum.
- F. Expansion Anchors for Installation After Concrete is Cast: Zinc-plated carbon steel wedge type with stainless steel expander clip 1/2-in. bolt size, 5,300-lb rated pull-out

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strength, and 6,800-lb rated shear strength, minimum.

- G. Cable Stanchions: Hot-rolled, hot-dipped galvanized "T" section steel, 2-1/4-in. size, punched with 14 holes on 1-1/2-in. centers for cable arm attachment.
- H. Cable Arms: 3/16-ga hot-rolled, hot-dipped galvanized sheet steel pressed to channel shape, approximately two 12-in. wide by 14-in. long and arranged for secure mounting in horizontal position at any position on cable stanchions.
- I. Cable Support Insulators: High glaze, wet process porcelain arranged for mounting on cable arms.
- J. Ground Rods: Solid copper clad steel, 3/4-in. dia by 10-ft. length.
- K. Ground Wire: Stranded bare copper, No. 6 AWG, minimum.

2.05 PRE-CAST MANHOLES AND HANDHOLES

- A. Factory fabricated of reinforced concrete in conformance with ANSI C2 and applicable requirements of ASTM C478. Design manhole structure in accordance with requirements of American Association of State Highway and Transportation Officials (AASHTO) publication "Standard Specifications for Highway Bridges." AASHTO H20 highway loading shall apply with 30% loading added for impact.
- B. Pre-cast Units: Interlocking, mating sections complete with accessory items, hardware, and features as indicated including concrete knockout panels for conduit entrance and sleeve for ground rod.
- C. Joint sealant for joints between pre-cast sections shall be continuous extrusion of asphaltic butyl material compounded for adhesion, cohesion, flexibility, and durability properties required for permanent seal against maximum hydrostatic pressures theoretically attainable at installation location with ground water level at grade.

2.06 RACEWAY/DUCT SEALING COMPOUND

- A. Compound:
 - 1. Non-hardening, putty-like consistency workable at temperatures as low as 35°F.
 - 2. Compound shall not slump at temperature of 300°F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

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PART 3 EXECUTION

3.01 WIRING METHOD

- A. General: Install ducts for wiring runs indicated. Provide sizes as indicated.
- B. Single Duct Runs: Rigid galvanized steel conduit, direct buried in earth where shown on plans.
- C. Duct Banks: Rigid nonmetallic conduit, Schedule 40 or 80, encased in concrete, unless shown otherwise on plans.

3.02 EXCAVATION AND BACKFILL

- A. Excavation: Cut trenches neatly and uniformly, and slope uniformly to required pitch.

3.03 INSTALLATION OF DUCTS

- A. Slope: Pitch ducts to drain towards manholes and handholes and away from buildings and equipment, unless otherwise shown on Drawings. Minimum slope shall be 4 in. in 100 ft. Where necessary to achieve this between manholes, slope ducts from high point in run to drain in both directions.
- B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. For other curves and bends, except as otherwise indicated, use manufactured long sweep bends with minimum radius of 25 ft. in both horizontal and vertical directions.
- C. Make joints in ducts and fittings watertight in accordance with manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Handholes: End bells spaced approximately 10 in. center to center for 5-in. ducts and varied proportionately for other duct sizes. Change from regular spacing to end bell spacing shall start 10 ft. from end bell and shall be made without reducing duct line slope and without forming trap in line. Grout end bells into manhole walls from both sides to provide watertight entrances. Provide groundable end bushings on metal ducts and connect to system grounding conductor.

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- E. Duct Entrances to Buildings: Transformations from underground PVC duct to steel conduit shall be made 10 ft. minimum, outside building wall and shall use fittings manufactured for purpose. Install in accordance with following:
1. Concrete-Encased Ducts: Install reinforcing in duct banks through disturbed earth near buildings and excavations and coordinate duct bank with structural design at wall so duct bank is supported at wall without reducing structural or watertight integrity.
 2. Direct-Buried, Non-encased Duct Entering Non-waterproofed Walls: Install Schedule 40 galvanized steel pipe sleeve for each duct. Caulk space between conduit and sleeve with duct sealing compound on both sides for moisture-tight seal.
 3. Waterproof Entrances: Where ducts enter buildings through waterproofed floor or wall, watertight entrance-sealing device shall be installed with sealing gland assembly on inside. Anchor device securely into masonry construction with one or more integral flanges and membrane waterproofing secured to device in permanently watertight manner.
- F. Concrete-Encased Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install in accordance with following:
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel in such way as to form conductive or magnetic loops around ducts or duct groups.
 2. Reinforcing: Reinforce duct banks. Size and arrange reinforcing steel as indicated on Drawings.
 3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in one continuous operation unless approved by Engineer. Where more than one pour is necessary, terminate each pour in vertical plane and continue duct bank reinforcing minimum

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of 18 in. beyond termination of pour.

4. Forms: Walls of trench may be used to form side walls of duct bank provided soil is self-supporting and concrete envelope can be poured without soil inclusions. Use forms where soil is not self-supporting.
5. Minimum Clearances: 3 in. between ducts and exterior envelope wall, 3 in. between ducts for like services, and 6 in. between power and ducts for other systems.
6. Depth: Except as otherwise indicated, top of duct bank shall be 24 in. below finished grade, minimum, in non-traffic areas, and 30 in. below finished grade, minimum, in vehicular traffic areas.

G. Stub-ups: Duct stub-ups to equipment shall be galvanized rigid steel. For equipment mounted on outdoor concrete pads, steel conduit shall extend minimum of 5 ft. away from edge of pad. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for purpose and encased concrete.

H. Sealing: For ducts to be wired in this Project, provide temporary closure at terminations. For spare ducts, seal bore of ducts at terminations. Use sealing compound and plugs as required to withstand 15 psi minimum hydrostatic pressure.

I. Pulling Cord: Provide 100-lb test nylon cord in ducts including spares.

J. Marker Tape: Provide plastic marker tape over ducts at 12 in. below finished grade.

3.04 INSTALLATION OF MANHOLES/HANDHOLES, GENERAL

A. General:

1. Provide manholes/handholes of sizes, shapes, and locations as indicated.
2. Determine final elevation of ducts as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing manholes/handholes. Obtain Engineer's approval for manhole/handhole installation adjustments necessitated by obstructions.
3. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.

B. Elevation:

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1. Manholes: Install with roof top 15 in. below finished grade, minimum.
 2. Manholes: Install handholes with depth as indicated. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1-in. above grade.
- C. Drainage: Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.
- D. Access: Install access to manhole/handhole through cast-iron frame and cover. For manholes, use 30-in. cover except as indicated. Use 30-in. cover for handholes, except use 24-in. covers for 2-ft. by 2-ft. handholes. Install brick chimney to support frame and cover and to connect cover with manhole/handhole roof opening. Provide moisture-tight masonry joints and waterproof grouting of cast iron frame to chimney. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1-in. above finished grade.
- E. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least 3 days. After ducts have been connected and grouted in, and prior to backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole/handhole chimneys after brick mortar has cured at least 3 days.
- F. Dampproofing: Apply dampproofing to exterior surfaces of units after concrete has cured 3 days, minimum. After ducts have been connected and grouted in, and prior to backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole/handhole chimneys after brick mortar has cured at least 3 days.
- G. Hardware: Install removable hardware including pulling eyes, cable stanchions, cable arms, and insulators as required for installation and support of cable and conductors and as indicated.
- H. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 in. for anchor bolts installed in field. Use minimum of 2 anchors for each cable stanchion.
- I. Grounding: Install ground rod through floor of each manhole/handhole with top protruding 4 in. above floor. Seal floor opening against water penetration with waterproof non-shrink grout. Ground exposed metal components and hardware with bare copper ground conductor. Train conductors neatly around corners. Install on walls and roof using cable clamps secured with expansion anchors.

3.05 INSTALLATION OF CAST-IN-PLACE MANHOLES/HANDHOLES

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- A. Construct manholes/handholes as indicated.
- B. Finish interior surfaces with smooth troweled finish.
- C. Windows for future duct connections shall be concrete knock-out panels 1-1/2 to 2 in. thick, located as indicated.

3.06 INSTALLATION OF PRECAST MANHOLES/HANDHOLES

- A. Install in accordance with ASTM C891 and manufacturer's instructions.
- B. Support units on level bed of crushed stone or gravel, graded from 1-in. sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.07 TESTING

- A. Field Quality Control:
 - 1. Grounding: Test manhole grounding provisions to ensure electrical continuity of bonding and grounding connections. Make ground-resistance test at each ground rod and submit report of results. Use an instrument specifically designed for ground-resistance measurements.
 - 2. Duct Integrity: Rod ducts with mandrel 1/4-in. smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove obstructions and retest.
 - 3. Water Tightness: Make internal inspection of manholes/handholes three months after completion of construction for indications of water ingress. Where leakage is noted, remove water found and seal leakage sources. Re-inspect after two months and reseal remaining leakage sources. Repeat process at two month intervals until leakage is corrected.

3.08 CLEANING AND RESTORATION

- A. Clean Ducts: Clean full length of ducts with a round bristle brush with dia 1/2-in. greater than internal diameter of duct.
- B. Clean Manholes: Clean internal surfaces of manholes including sump. Remove foreign material.

3.09 RESTORATION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

UNDERGROUND DUCTS AND MANHOLES

- A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.
- B. Where sod has been removed, replace it as soon as possible after backfilling is completed.
- C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work to their original condition.
- D. Include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.
- E. Restore disturbed paving as indicated.

END OF SECTION

SECTION 16120

600 VOLT BUILDING WIRE AND CABLE

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SECTION INCLUDES

- A. Specifications for 600-volt building wire and cable.
- B. Specifications for VFD cable.

1.02 REFERENCES

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC):
 - 1. Article 310 - Conductors for General Wiring.
 - 2. Article 200 – Use and Identification of Grounded Conductors.
- B. Underwriter's Laboratories (UL)
 - 1. UL 83: Thermoplastic Insulated Wires and Cables
 - 2. UL 1063: Machine Tool Wires and Cables
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM B3: Soft or Annealed Copper Wires
 - 2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

600 VOLT BUILDING WIRE AND CABLE

- D. Insulated Cable Engineers Association (ICEA), ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

1.03 SUBMITTALS

- A. Submit the following for Engineer's approval.
 - 1. Manufacturer's cut sheets and catalog data
 - 2. Instruction for handling and storage
 - 3. Dimensions and weight
- B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

- A. Tests. Cable shall meet all the requirements of Part 6 of ICEA S-61-402.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.00 ACCEPTABLE MANUFACTURERS

- A. Cerro
- B. Southwire
- C. Service Wire Company

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

600 VOLT BUILDING WIRE AND CABLE

2.01 MATERIALS AND EQUIPMENT

- A. Design. Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90° C in dry locations and 75° C in wet locations while installed in underground duct, conduit or in control panels (MTW). Use XHHW, 90° rated conductors for main service or feeders.
- B. Conductors. Provide conductors, which are Class B, concentric stranded, annealed uncoated copper with physical and electrical properties complying with ASTM B3 and B8 and Part 2 of ICEA S-61-402.
- C. Insulation. Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of Part 3 of ICEA S-61-402. The insulation thickness shall match the dimensions listed in NEC Table 310-13 for type THHN and THWN wire.
- D. Wire Marking
1. Wire marking shall be in accordance with NEC Article 310-11 and shall be printed on the wire insulation at 2-foot intervals.
 2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color.
- E. The single conductor color coding shall be as follows:

<u>System Voltage</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Neutral</u>
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey
Motor Control	1	Black		
	2	Red		
	3	Blue		
Ground	Green			

- 2.02 VFD cables are to be selected and provided for AC motor drive duty and shall be rated at voltage listed in VFD Manufacturer's data sheets.
- 2.03 All service and feeder conductors to be XHHW-2.
- 2.04 Provide composite multi-conductor, shielded pair or triad, outer sheathed cables where shown on plans.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

600 VOLT BUILDING WIRE AND CABLE

PART 3 EXECUTION

3.00 PREPARATION

- A. Complete the cable raceway systems and underground duct banks before installing cables.
- B. Verify sizing of raceways and pull boxes to ensure proper accommodation for the cables.
- C. Check the length of the cable raceway system against the length of cable on the selected reel.
- D. Clean conduits of foreign matter before cables are pulled.

3.01 INSTALLATION

A. Wiring Methods

- 1. Use wiring methods indicated on the Drawings
- 2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring where conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels. Use XHHW, 90° rated conductors for main service or power and motor feeders.
- 3. Do not use solid conductors.
- 4. Use conductors no smaller than No. 12 AWG stranded for lighting circuits indoors and not smaller than No. 10 AWG stranded for outdoors. Use No. 10 AWG (minimum) for outdoor receptacles on structures or poles.
- 5. Use conductors no smaller than No. 14 AWG for control circuits, except when part of a multi-conductor cable or internal panel wiring.
- 6. In general, do not splice conductors. All conductors must be one continuous length from starting point to end point without splices, unless prior written approval by Engineer.
- 7. Splices associated with taps for lighting and control circuits are allowed without approval.
- 8. Make splices in accessible junction boxes located above ground. Do not splice power and control conductors in underground pull boxes or manholes, unless specifically allowed. Any splices allowed in underground boxes shall be made

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

600 VOLT BUILDING WIRE AND CABLE

using 3M water tight kits specifically made to withstand submergence in water. Any conductors allowed to be spliced in underground boxes shall have conductors elevated to near top of wall.

9. Wire nuts with insulated caps may be used for lighting wiring splices located in wall boxes, switch boxes, and receptacle boxes, but not in control panels, MCC's or underground boxes. Splice control circuit with insulated crimp connectors.
10. All conductors routed in manholes, electrical vaults and underground pull boxes shall be routed around walls and supported by nonmetallic fiberglass unistrut that is bolted vertically to walls at intervals not less than two per wall. Do not use horizontal arms unless specifically called for. Support conductors with stainless steel bands made for the purpose of supporting conductors, or with large wide nylon Ty-Wraps. Under no conditions shall conductors be routed directly across length of box. Any conductors routed otherwise shall be removed and replaced at Contractors expense. Splicing in UG pull boxes, manholes or vaults is prohibited without written approval by Engineer.

B. Single Conductor in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.
3. Splices are not allowed in manholes.

C. Single Conductor in Cable Tray: Do not install single conductor building wire and cable in cable tray. All conductors to be tray rated composite cable type.

D. Multi-Conductor Shielded VFD Rated Cable:

1. Install cables in accordance with the manufacturer's instructions.
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.
3. Do not splice cables unless specifically shown on plans. Provide as one continuous length. Where splicing is shown on plans or approved, use mechanical compressing tools and splice barrels only, and tape connections.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

600 VOLT BUILDING WIRE AND CABLE

4. All cables and conductors routed thru UG pull boxes or manholes shall be routed around walls and secured on racks. See plans for details.
- E. Preparation for Termination
1. Make 600-volt power cable terminations and splices with heat shrinkable sleeves and seals.
 2. Terminal lugs and connectors for all sizes of conductors shall be crimp-on type.
 3. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole tongues except in places where termination space is limited.
- F. Tests:
1. In general, test insulation integrity of the wiring system before terminating.
 2. Make sure to disconnect sensitive electronic equipment before testing insulation.
 3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.
- G. Termination: After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.
- H. Inspection of Conductors
- I. All conductors shall be inspected for damage after pulled in conduit. Where damage is deemed excessive by Engineer, conductors shall be replaced for entire length of run.
- J. Where damage is due to condition of conduits, Contractor may be requested to provide a televised inspection of conduits at no additional cost to Owner and where deemed necessary by Engineer, any damaged conduits shall be replaced at no additional cost to Owner.

END OF SECTION

SECTION 16126
INSTRUMENTATION CABLE

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 – “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SECTION INCLUDES

- A. Specifications for instrumentation cable.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM B3: Soft or Annealed Copper Wires.
 - 2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.
 - 3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.
- C. Insulated Cable Engineers Association (ICEA).
 - 1. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).
 - 2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7).
 - 3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

INSTRUMENTATION CABLE

D. Underwriters' Laboratories (UL).

1. UL 44: Rubber Insulated Wires and Cables.
2. UL 83: Thermoplastic Insulated Wire and Cables.

E. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials, Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.

1.03 SUBMITTALS

A. Submit all products covered under this Section for Engineers approval.

1. Completed engineer's data sheets from this specification or manufacturer's data sheets, cut sheets, and catalog data.
2. Installation, terminating and splicing procedure (including bending radius and pulling tension data).
3. Instruction for handling and storage.
4. Dimensions and weight.

B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

A. Tests

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of ICEA Section 7.7.9 of S-66-524 or 7.5.9 of S-68-516.
2. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

INSTRUMENTATION CABLE

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Alpha Wire Corporation
- B. Belden Division, Cooper Industries, Inc.
- C. Cablec Continental Cables Company
- D. General Cable Company
- E. Manhattan Electric Cable Corporation
- F. Okonite Company

2.02 MATERIALS AND EQUIPMENT

- A. Design. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil, and sunlight resistant, and certified for continuous operation at the temperature specified in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified. Each conductor shall be individually insulated. Pairs and triads shall have conductors, which are twisted together with a drain wire, shielded, and covered with a jacket. Multi-pair/triad cables shall consist of the required number of electrically isolated, shielded pairs or triads, which are bundled together and covered by an overall jacket as specified. Provide composite multi-conductor, shielded pair or triad, outer sheathed cables where shown on plans.
- B. Conductors. Provide conductors, which are Class B, concentric stranded, annealed tinned copper whose physical and electrical properties comply with ASTM B3, B8 or B33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516, unless otherwise specified.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

INSTRUMENTATION CABLE

- C. Insulation. Each conductor shall be insulated as specified in compliance the requirements of Part 3 of ICEA S-61-402, S-66-524, or S-68-516. The average insulation thickness shall not be less than the dimensions shown in Table 7-32 or 7.5.1 of ICEA S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.
- D. Drain Wire. Provide drain wire which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33 and as specified. The drain wire shall not be less than two AWG sizes smaller than the insulated conductor's size, except for multiple pair triad drain wires, which shall not be less than the insulated conductor size.
- E. Shielding. Provide shielding consisting of laminated, non-burning, mylar-backed aluminum tape applied helically around a twisted pair or triad with the aluminum side in continuous contact with the drain wire unless otherwise specified. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap unless otherwise specified.
- F. Jacket. The physical and electrical properties of the jacket used to cover single or multi-pair or triad cables shall meet the requirements of section 7.7.7 or ICEA S-66-524 or section 7.5.6 of ICEA S-68-516. Jacket material as specified. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516.
- G. Armor. Where requested, use instrumentation cables protected by an interlocked metal tape armor coating made of galvanized steel, which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524, unless otherwise specified.
- H. Conductor Identification. Use individual conductors in single-pair and single-triad cables, which are, color coded black and white; and black, white and red, respectively. Multi-pair-triad cables shall have one conductor in each pair or triad colored white, and all other conductors are color coded in sequence according to Table L-2 of Appendix 2 of ICEA S-66-524, and as specified.
- I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with color sharply contrasting the jacket color.

PART 3 EXECUTION

3.01 PREPARATION

- A. Complete cable raceway systems, underground duct banks, and cable support systems before installing cables.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

INSTRUMENTATION CABLE

- B. Verify sizing of raceways and pull boxes to ensure proper accommodation for the cables.
- C. Check the length of the cable raceway system against the length of cable on the selected reel.
- D. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 degrees F.
- E. Clean conduits of foreign matter before cables are pulled.
- F. Provide at least 30 percent spare conductors or pairs.

3.02 INSTALLATION

- A. Cable in Conduit and Ductbank
 - 1. Install cables in accordance with the manufacturer's instructions and NEC Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling and Power Limited Circuits. Do not exceed maximum wire tension, maximum insulation pressure, and minimum bending radius.
 - 2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket.
 - 3. Conduits carrying low level signal cables shall be PVC-coated rigid steel.
- B. Cable in Tray. Install instrument and signal cable in cable tray only when the tray is dedicated for this type cable and cables are approved for tray installation.
- C. Termination
 - 1. Do not splice conductors. For termination use crimp-on type ring tongue non-insulated tin plated copper lugs.
 - 2. For shielded control cable, terminate the shield and ground it at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables.
 - 3. If splicing is required, maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.

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INSTRUMENTATION CABLE

4. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire markers after the ring tongue terminal has been installed. Extend the marker over the crimp or base of the terminal.
- D. Tests
1. Before connecting the cables, test insulation integrity and conductor continuity.
 2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.
- E. Termination. After the cable has been tested with satisfactory results, the cable can be terminated at both ends to their designated terminal points.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEVICE, PULL AND JUNCTION BOXES

SECTION 16131

DEVICE, PULL AND JUNCTION BOXES

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SECTION INCLUDES

- A. Specifications for device, pull, and junction boxes.

1.02 REFERENCES

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).
 - 1. FB1 - Fittings and Support for Conduits and Cable Assemblies
 - 2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)
- B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 314 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.
- C. Underwriters Laboratories (UL):
 - 1. 50 - Safety Cabinets and Boxes
 - 2. 508 - Safety Industrial Control Equipment
 - 3. 514B - Safety Fittings for Conduit and Outlet Boxes
 - 4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas.
- D. **National Electrical Code – Article 110, Section V – Manholes and other Electric Enclosures Intended for Personnel Entry – All Voltages.**

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEVICE, PULL AND JUNCTION BOXES

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer’s approval.
 - 1. Manufacturer's cut sheets, catalog data
 - 2. Instruction for handling and storage
 - 3. Installation instructions
 - 4. Dimensions and weights
- B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling, and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Sheet Metal Boxes
 - 1. Hoffman Industrial Products
 - 2. Pauluhn Electric Manufacturing Company
 - 3. Hennessy
 - 4. Tanco
 - 5. Tejas
 - 6. Circle A.W.
- B. Cast Device Boxes
 - 1. Appleton Electric Company

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEVICE, PULL AND JUNCTION BOXES

2. Crouse-Hinds, Division of Cooper Industries
3. Killark Electric Manufacturing Company

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet areas, NEMA 250 and NEC Article 314. Enclosures located outdoors or in environmentally harsh or wet locations shall be NEMA 4X 316 stainless steel.
2. Provide boxes with a stainless steel continuous hinge, closure hasps and all-stainless steel hardware.
3. Furnish the door with neoprene gasket and provision for padlock.

B. Device Boxes:

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 314.
2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.
3. All boxes located in environmentally harsh or wet or outdoor locations shall be NEMA 4X 316 stainless steel.
4. All boxes located in chemical rooms shall be H.D. PVC only.
5. Where unprotected service conductors are routed through a pull box with other conductors a divider wall shall be provided in the pull box for separation as required by the NEC.

C. Hardware

1. Mounting Hardware: Stainless steel
2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DEVICE, PULL AND JUNCTION BOXES

PART 3 EXECUTION

3.01 PREPARATION

- A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.02 INSTALLATION

- A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.
- B. Install boxes in accordance with NEC Article 314 in locations indicated on the Drawings.
- C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance, and repair.
- D. Plug unused conduit openings.
- E. Make conduit connections to sheet metal boxes with watertight conduit connectors.
- F. Size underground pull boxes and manholes large enough to allow cables and conductors to be routed around walls and supported on wall racks. See plans for details. Do not use arms on mounted racks, except for MV cables or large multiple 600 Volt cables. Do not cross and occupy middle of pull box or manhole with cables or conductors.

END OF SECTION

**SECTION 16140
WIRING DEVICES**

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Section 16012 – “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SECTION INCLUDES

- A. Specifications for wiring devices including:
 - 1. Receptacles.
 - 2. Wall switches.
 - 3. Wall plates and cover plates.

1.02 REFERENCES

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
 - 1. NEMA WD1 - General Purpose Wiring Devices.
 - 2. NEMA WD6 - Dimensional Requirements.
- B. Federal Specifications (WC-596F).
- C. American National Standards Institute/National Fire Protection Association (NFPA):
 - 1. NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 406 Receptacles, Cord Connectors, and Attachment Plugs (Caps).

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

WIRING DEVICES

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer's approval:
 - 1. Manufacturer's product literature and specifications including dimensions, weights, certifications, and instructions for handling, storage, and installation.
- B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling, and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Bryant Electric
- B. Crouse-Hinds, Arrow Hart Division
- C. Hubbell Inc. Wiring Devices Division
- D. Leviton Manufacturing Company
- E. Pass & Seymour/Legrand.

2.02 MATERIALS AND EQUIPMENT

- A. Standards: Conform to NEMA WD1 for general requirements and NEMA WD6 for dimensional requirements.
- B. Manufacture devices to heavy-duty industrial specification grade with ivory nylon bodies (orange for isolated-ground receptacles) back and side wiring provisions and green-colored grounding screws.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

WIRING DEVICES

C. Receptacles:

1. Duplex-type receptacles: Rated 20 amps at 120 volts.
2. Contacts: Brass or phosphor bronze.
3. Receptacle grounding system: Extend to the mounting strap unless isolated ground is indicated or required.
4. GFI or GFCI (ground fault circuit interrupter) receptacles: Provide feed-through type with test and reset button. Use individual GFI receptacle at each location. Do not daisy chain unless specifically allowed.

D. Wall Switches:

1. Toggle switches: Rated 20 amps at 120/277 volts AC rated for both resistive and inductive loads.
2. Contacts: Silver cadmium oxide construction to prevent sticking, welding and excessive pitting.

E. Cover Plates:

1. In outdoor, corrosive, and wet areas, provide cover plates of cast metal, gasketed with spring-loaded hinged covers and stainless steel hardware.
2. All other plates: Type 302 stainless steel.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that device boxes are correctly placed.
- B. Verify that the correct quantity, size, and type of wires are pulled to each device box.
- C. Verify that wiring has been checked at both ends.
- D. Prepare wire ends for connection to devices.
- E. Inspect each wiring device for defects.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

WIRING DEVICES

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top.
- E. Connect wiring device grounding terminal to outlet box with bonding jumper.
- F. Connect wiring devices by wrapping conductors clockwise around screw terminals.
- G. Install cover plates on switch, receptacle, and blank outlets in finished areas.
- H. Energize and test devices for proper operation.
- I. Use screw connections for wires. No push-in connections allowed.
- J. Only two (2) wires per screw terminal allowed. No conductor splices in receptacle box. Use separate box for splicing.
- K. Do not connect motor loads of any type to receptacle terminals.
- L. For water and wastewater plant equipment buildings, process buildings, MCC rooms, blower rooms, equipment structures, pump rooms, lift stations and other facilities, except office buildings and control rooms, install receptacles at 48 inches AFF. Install receptacles and light switches at ADA required heights.
- M. Install GFI receptacles for receptacles in wet areas, pump rooms and all outdoor locations. Provide W.P. covers.
- N. Do not daisy chain receptacle off of a single GFI receptacle; Use separate GFI receptacle at each location.

END OF SECTION

SECTION 16150
ELECTRIC MOTORS

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Observe electrical plans, motor protection unit specifications, and all equipment specifications to verify additional requirements before bidding. Vendor’s failure to do so is at Vendor’s own risk and at no additional cost to Owner for providing everything called for in plans and specifications.

1.01 SUMMARY

- A. Description of Work:
 - 1. Motors furnished under other sections of these Specifications as part of equipment items shall conform to requirements of this section except as noted otherwise in that section or indicated otherwise on Drawings or schedules.
 - 2. Submersible well motor shall be supplied in accordance with other sections of this specification.
 - 3. Blower and booster pump motors shall conform to any additional requirements by Equipment Manufacturers where noted in other specifications.

1.02 REFERENCES

- A. Refer to latest addition of following standards.
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. NEMA MG 1-Motors and Generators.
 - b. NEMA MG 1 - Part 31

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2. Institute of Electrical and Electronic Engineers (IEEE): IEEE Standard 112-Standard Test Procedure for Polyphase Induction Motors and Generators.
3. Anti-Friction Bearing Manufacturers Association (AFBMA): AFBMA Standards for Ball and Roller Bearings and Balls.
4. National Electrical Contractors Association (NECA): Standard of Installation.

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer's approval.
- B. Include motor submittal as part of equipment submittal for equipment specified in other sections.
- C. Include identification of equipment by name and tag number as indicated in Specifications or on Drawings.
- D. Submit in accordance with General Conditions and other applicable sections of the Contract Documents.
 1. Complete nameplate data in accordance with NEMA standards. Include space heater wattage and voltage. Include sound pressure rating.
 2. Full load power factor and maximum correction capacitor kVA for motors 5 hp and larger.
 3. Nominal efficiency in accordance with IEEE 112 for motors 5 hp and larger.
 4. Insulation in accordance with NEMA MG 1, Part 31 or, as stated elsewhere in this specification.
 5. Motor dimensions and frame size.
 6. Manufacturer's printed data on each motor type being provided to indicate compliance with specified performance and construction.
 7. Service manual to include storage and alignment instructions.
 8. Complete motor winding and bearing, RTD curve data, and provide motor temperature ratings.

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9. All motor characteristics and data required for programming Multilin motor protection where described in Section 16662 – “Motor Management Relay” or, as shown on plans. Submittals without this data will be rejected in entirety. Data to include:
 - a. Motor full load current
 - b. Locked rotor current
 - c. Locked rotor time-hot
 - d. Locked rotor time -cold
 - e. Hot: Safe stall ratio
 - f. Service factor
 - g. Overload/thermal damage curves
 - h. Running cool time
 - i. Stopped cool time
 10. No motor data shall be submitted until motor horsepower, voltage, and phase have been coordinated with MCC and Controls Manufacturer. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- E. Operation and Maintenance (O&M) Data: Submit in accordance with General Conditions, Section 16012 – “Electrical Work” and other applicable sections of the Contract Documents.
- F. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- 1.04 QUALITY ASSURANCE
- A. Source Quality Control:
1. Perform individual motor test on motors over 1 horsepower.

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2. Test shall be standard NEMA routine production test in accordance with MG 1-12.51, and consisting of following.
 - a. No load running current.
 - b. Locked rotor current.
 - c. High potential test.
 - d. Bearing inspection.
 3. Provide motor data to motor control center (MCC) or motor starter supplier at time MCC is ordered to assure coordination of control and overcurrent protective devices.
- B. Regulatory Requirements:
1. National Fire Protection Association (NFPA): NFPA No. 70 - National Electrical Code (NEC).
 2. Underwriters Laboratories, Inc. (UL).
 3. Local codes and ordinances.

PART 2 PRODUCTS

2.00 GENERAL

- A. Use of manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired.
- B. Unless otherwise specified, meet or exceed following requirements for general-purpose motors:
 1. High efficiency, equivalent to U.S. Motors premium efficiency for motors 5 hp and above.
 2. Motors 1/2 hp and Larger: 3-ph, 60 Hz, 230/460V or 240/480V.
 - a. Squirrel cage type, NEMA B.

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- b. Motor Housing and Bearing Brackets: Cast grey iron with tensile strength of 30,000 psi. Do not provide rolled steel and aluminum.
 - c. Secure bearing brackets to motor cast iron housing. Do not use bolt-clamping methods.
 - d. Provide dual voltage windings, 230/460V or 240/480V.
- 3. Motors Less than 1/2 hp: 1-ph, 60 Hz, 115/230V, 120/240V, or 120/208V.
 - a. Provide dual voltage windings.
- 4. Motor Operated Valve Motors: Provide dual voltage windings, 240/480V, 3 phase or 208/480V, 3 phase as required by plans.
- 5. Suitable for continuous operation with line voltage variation within $\pm 10\%$ of rated voltage.
- 6. Suitable for continuous operation in 40°C ambient with 80°C temperature rise.
- 7. Copper motor windings.
- C. Design for frequent starting. Coordinate with programming of motor protection devices, such as Multilin, for number of starts limitations.
- D. Provide internal, 120 VAC, heaters sized per manufacturer's recommendations based on use and location. Provide stamped stainless steel nameplate with space heater wattage and voltage. Install heaters in lower winding area of vertical motors. Contractor to provide 120 volt circuits from low voltage panel via starter contactors.
- E. Provide RTD's where shown on plans or required by specifications, by motor manufacturer or, where shown on drawings. Provide RTD's for both end bearings and for three phase windings. Provide RTDs for all VFD drives and motors 50 horsepower and greater. Provide vibration sensors where indicated on plans. Contractor to provide shielded circuits from motors to controls per RTD manufacturer requirements.
- F. Where used in conjunction with electronic variable speed drive units such as VFD's, coordinate with drive equipment manufacturer to provide a matched motor and drive system. Motor shall be capable of safe operation, without over heating, throughout full speed range of VFD. Failure to coordinate will result in any additional charges to be paid by Contractor at no additional cost to Owner.

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- G. Contractor to coordinate motors and MCC construction to assure starter, MCP and breaker sizes are properly sized for each motor and are satisfactory for safe operation. Where required by high efficiency or high inrush motor design criteria, all devices and conductors shall be adjusted as required. Failure to coordinate will result in any additional charges to be paid by Contractor at no additional cost to Owner.
- H. Where specific equipment specifications motor requirements conflict with this specification, Contractor, Vendor, Supplier and Manufacturer shall contact Engineer for clarification before bidding or, shall be responsible for providing motors with the more stringent requirements.
- I. The general requirements of this specification shall be followed where the more specific sections do not apply.
- J. All submersible pump over-temperature and seal leak modules shall have latching circuit with reset and alarm indicator light built-in or provided as external circuitry.
- K. Coordinate location of motor terminal box to match location of conduit stub up, drop or connection on same side of motor.
- L. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions.

2.01 MANUFACTURERS

- A. U.S. Motors
- B. General Electric
- C. Marathon
- D. As indicated in equipment specifications.
- E. Or equal, as approved by Engineer.

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2.02 ENCLOSURES - GENERAL

- A. Open Drip Proof (ODP): Indoor areas where clean, dry, and well ventilated, unless shown with more stringent requirement in other specification or on plans.
- B. Totally Enclosed, Fan Cooled (TEFC): Indoor or outdoor areas where exposed to corrosive vapors, driving rain or washdown activities. All locations for wastewater facilities.
- C. Provide enclosure indicated on Plans.
- D. Or, as approved by Engineer in writing.

2.03 INSULATION - GENERAL

- A. Dripproof Motors: Class F, 1.15 service factor.
 - 1. Two extra dips and bakes of epoxy varnish.
- B. Totally Enclosed Fan Cooled: Class F, 1.15 service factor.
 - 1. Two extra dips and bakes of epoxy varnish.
- C. **All Well Motors and All VFD Driven Motors: Provide 1600-volt insulation, or 3.1 times motor rated voltage and rise time of 0.1 microseconds per NEMA recommendations.**

2.04 BEARINGS - GENERAL

- A. Ball or roller bearing type at manufacturer's option, unless specified in equipment sections of Specifications.
- B. Support side thrust loadings.
- C. Re-greaseable with alamite fittings extended to accessible location for Frame 250 and larger.
- D. AFBMA B10 bearing life rated (flexible coupled) at 50,000 hrs.
- E. **For VFD driven motors 100 hp and greater, provide insulated bearing at one end and shaft grounding ring at other end. For motors less than 100 hp, provide a shaft grounding ring at either end of motor.**

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2.05 SPEED

- A. As specified under equipment section and as required by specific applications.

2.06 TORQUE - GENERAL

- A. Breakdown torque shall be 200% or more of maximum torque load placed on motor shaft.
- B. Provide necessary WK₂ curves for special loads to coordinate with motors.
- C. Supply special motors where load requirements exceed standard design.

2.07 SLIDE RAILS AND SOLE PLATE

- A. As required for application. Provide as furnished by or, as recommended by, Motor Manufacturer.

2.08 SINGLE PHASE FRACTIONAL HP MOTORS

- A. Capacitor or open split phase start, unless otherwise noted.

2.09 THREE PHASE MOTORS - GENERAL

- A. Provide horizontal or vertical squirrel cage induction motors for standard duty.
- B. Full voltage starting or, as specified in equipment sections of specifications or, on plans. Use reduced voltage autotransformer starting for motors as indicated, rated 100 horsepower and greater or, use solid-state starter where specifically shown otherwise on plans.
- C. Provide low pass filter protection for VFD driver motors 10 horsepower to 500 horsepower where conductor length between VFD and motor exceeds 50 feet.

2.10 VERTICAL MOTORS

- A. This section provides guidelines for design and manufacture of low and medium voltage vertical squirrel cage induction motors on larger than NEMA size frames.
- B. Conditions of Service
 - 1. Motors shall be suitable for continuous operation on a three phase, 60-hertz system rated 240 or 480 volts.

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2. Motors shall be designed to operate at rated load in a minimum ambient temperature of 40°C at maximum altitude of 1,000 meters.
3. The location of installation will be either indoors or outdoors as dictated by the specific provisions for each motor.

C. Design Requirements

1. Motors shall be capable of withstanding all normal forces, which may be imposed upon them during the course of normal operation, including starting and normal stops.
2. Motors shall be suitable for across the line starting and shall be able to start and accelerate the connected load to full load speed with 90% of rated voltage at the motor terminals. Where shown on plans or, noted in specifications, motors shall be suitable for reduced voltage starting.
3. Motors shall be capable of continuous operation at full load and rated frequency with a voltage variation of $\pm 10\%$.
4. Motors shall be capable of continuous operation at full load and rated voltage with a frequency variation of $\pm 5\%$.
5. Motor starting current shall not exceed a value equal to 650% of the motor full load current.
6. Motor installation in hostile environments subject to dust, moisture, and/or corrosive atmospheric conditions shall have all parts given protective treatment such as U.S. Motors' "CORRO-DUTY®" or equal.

D. Enclosure:

1. Motors shall be furnished with enclosure types based on the location of installation and the specific requirements for each motor. Unless specifically noted otherwise in equipment specifications, all motors for this project are to be TEFC.

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2. Openings on all weather-protected designs shall be covered with metal guard screens having a mesh size no larger than ½ inch square.
 - a. Weather Protected Type I motors shall be designed to protect internal components from falling water and debris at angles up to 100 degrees from vertical.
 - b. When specified, Weather Protected Type II designs shall be furnished with removable, cleanable, and reusable air filters over intake air openings.
3. Enclosures shall be of fabricated steel or cast iron construction in accordance with the Manufacturer's standard design. Canopy caps shall be of aluminum, cast iron, or sheet metal and shall be easily removable for maintenance purposes.
4. Motors to be installed in locations where moisture may collect shall be furnished with drain openings and plugs. In the case of explosion-proof motors, drains and breathers shall be furnished and shall be of the type approved by UL.

E. Stator Construction

1. Stator laminations shall be of fully processed steel. Each lamination surface shall be given the necessary treatment so as to have core plate type C-5 insulation.
2. Stator windings for system voltages above 600 volts shall be form wound of rectangular copper magnet wire. Aluminum magnet wire is not acceptable. Individual coils shall be insulated with mica bearing tape prior to insertion.

Coil extensions shall be blocked and braced sufficiently to minimize movement during normal starting and running conditions at full rated voltage.
3. Insulation system shall be Class B or better.
4. Insulation systems shall receive a minimum of two (2) vacuum pressure impregnation treatments using a 100% solids epoxy resin.
5. When specified, a completely sealed insulation system shall be supplied. This system shall be capable of passing the NEMA MG1-20.48 water immersion test and shall be U.S. Motors' "EVERSEAL," or equivalent system.

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6. When specified, motors to be rated for variable frequency drive applications shall meet NEMA MG-1 Part 31 dated 1993 and shall be U.S. Motors' Inverter Grade® insulation system or equal. The insulation system shall be warranted for a minimum of 3 years operation on VFD power, which shall not be limited by maximum cable length restrictions.
 7. Temperature rise shall not exceed the limits defined by NEMA for Class B insulation systems while operating at nameplate horsepower, frequency, and voltage.
 8. In the case of a particular rating where a Class F temperature rise is required, motors shall be furnished with Class F or better insulation.
- F. Rotor Construction: Rotors shall be of cast or fabricated aluminum in accordance with Manufacturer's standard design.
- G. Bearings
1. Bearings supplied shall be of type and size sufficient to satisfy thrust loading requirements for each motor in accordance with manufacturer's standard design. Bearings shall be rated for a minimum in-service B-10 life of 50,000 hours.
 2. Thrust Bearings:
 - a. Motors shall be designed and constructed with thrust bearings on top to allow inspection and/or replacements without requiring complete disassembly of motor.
 - b. Thrust bearings shall be deep-groove ball, angular contact ball, or spherical roller type. Bearings mounted back-to-back or in tandem are acceptable and may be furnished when required according to Manufacturer's standard design.
 3. Deep-groove ball bearings shall be used only on normal thrust design motors and shall be capable of handling thrust loads in either direction.
 4. High thrust design motors shall be supplied with angular contact ball bearings whenever possible and in accordance with Manufacturer's standard design.
 5. Where thrust requirements restrict the use of angular contact bearings, spherical roller bearings shall be furnished.

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6. When required, motors furnished with spherical roller bearings shall also be provided with a system of coils in the oil reservoir for the circulation of cooling water.
7. Spherical roller bearings shall be spring loaded to keep the lower bearing race in contact and prevent bearing damage during starting and momentary upthrust conditions.

H. Guide Bearings:

1. Guide bearings shall be deep-groove ball type and shall be located at the bottom of the motor.
2. Guide bearings may be stacked when necessary according to Manufacturer's standard design to accommodate specified upthrust conditions.
3. Guide bearings or bearing assemblies shall be provided with sufficient means for preventing the leakage of lubricant or entrance of foreign matter along the shaft.

I. Lubrication

1. Thrust bearings shall be oil lubricated and contained in an oil reservoir with oil sight level gauge and oil fill and drain openings with plugs.
2. Deep-groove ball bearings furnished as thrust bearings for normal thrust motors shall be grease lubricated. When furnished as guide bearings for high thrust units, they shall be oil lubricated.
3. Grease lubricated bearings shall be furnished with provisions for in-service positive lubrication. A drain shall be provided to guard against over lubrication.

J. Noise Level: Sound pressure levels shall be measured according to IEEE 85 and shall not exceed 85 decibels as measured on the A-Weighted Scale at a distance of 1 meter from any motor surface under no load, free field conditions.

K. Nameplates:

1. Motors nameplates shall be of stainless steel and shall be securely fastened to the motor frame with pins of a like material. Nameplate data shall be pressure stamped into nameplate to form an embossed impression. Painted data is not acceptable except where painted in addition to embossed impression.

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2. The following information shall be contained on the motor nameplate as a minimum:
 - a. Rated Horsepower
 - b. Full Load Speed
 - c. Frequency
 - d. NEMA KVA Code and Design Letter (when applicable)
 - e. Rated Voltage
 - f. Manufacturer's Serial Number
 - g. Service Factor
 - h. Insulation Class
 - i. Maximum Ambient
 - j. Full Load Current at Nameplate Voltage
 - k. Frame Size Designation

L. Terminal Boxes

1. Terminal boxes shall be of fabricated steel or cast iron construction to be compatible with motor enclosure specified and when possible, shall be diagonally split and capable of rotation in 90° increments. Boxes not suitable for rotation must be capable of top entry.
2. The area in which the main terminal box is connected with the motor frame shall be fully gasketed in order to prevent entrance of foreign matter into the motor and to provide support for the stator leads where they pass through the motor frame.
3. A properly sized grounding terminal shall be mounted in the main terminal box when specified.
4. The motor terminal box shall be sufficiently oversized to allow stress cone terminals of shielded power cables and to allow mounting of any surge capacitors, lightning arrestors, or current transformers as may be specified.

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5. Size motor terminal box shall be adequately sized to accommodate conduits as shown on Plans or described in schedule.
6. Coordinate location of motor terminal box to match location of conduit stub up, drop or connection on same side of motor.

M. Leads:

1. Main motor leads shall have EPDM or equal type jackets and shall be permanently tagged for identification.
2. The relationship between lead markings and the direction of rotation shall be indicated on a separate motor nameplate.

N. Space Heaters

1. When specified motors shall be furnished with space heaters to provide sufficient wattage to maintain the internal temperature of the motor at a level approximately 10° C above the ambient temperature while the motor is not in operation.
2. Space heaters shall be of the silicone rubber strip type attached directly to the stator end turns. When specified, the leads shall be brought out to an auxiliary terminal box.
3. Space heaters shall be rated for operation on a single phase, 60 hertz, 120-volt system.
4. Space heater shall be energized via a temporary 120-volt circuit while motors are stored prior to installation, and shall be energized via the permanent 120-volt circuit after installation. Where motor is allowed to stand for extended periods exceeding one (1) day without heaters energized, Contractor shall have motor inspected by motor shop for corrosion. Where corrosive damage is found, motor shall be replaced with new motor.

O. Protective Devices

1. Stator winding protection shall consist of one or more of the following systems unless indicated otherwise in plans or specifications:
 - a. Six (6), 100 or 120 ohm nickel resistance-type temperature detectors (RTD's) embedded in the stator windings, two (2) per phase. Each detector shall have its leads wired to an auxiliary terminal box. Verify ohm resistance required with Motor Protection Unit Manufacturer.
 - b. One (1) positive temperature coefficient (PTC) thermistor temperature sensor embedded in each phase of the stator winding and corresponding solid-state electronic control. (Where indicated on plans) Thermistor system shall be U.S. Motors' "THERMA-SENTRY," or equal.
 - c. Three (3) bi-metallic thermostats of the automatic reset type, with normally closed contacts, mounted one (1) per phase. Each thermostat shall be furnished with leads suitable for connection to the control circuit. (Where indicated on plans)
2. Bearing protection shall consist of one of the following unless indicated otherwise in plans or specifications:
 - a. Two (2) 100 or 120 ohm nickel resistance-type temperature detectors (RTD's), one (1) per bearing, mounted as closely as possible to the outer surface of each bearing.

Each detector shall have its leads wired to a terminal block located in an auxiliary terminal box. Verify ohm resistance required with Motor Protection Unit Manufacturer.
 - b. Two (2) bearing temperature relays one (1) per bearing, furnished with indicating scale, where otherwise indicated in plans or specifications.
 - c. Two (2) dial type thermometers, one (2) per bearing.
 - d. Two (2) iron or copper constantan thermo-couples, one (1) per bearing, where otherwise indicated in plans or specifications.

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P. Testing

1. When specified motor shall be given a complete initial test in accordance with IEEE 112 method B and shall include the following items:
 - a. Current Balance
 - b. High Potential Test
 - c. Vibration Test
 - d. Winding Resistance
 - e. Locked Rotor Current
 - f. No Load Running Current
 - g. Full Load Heat Run
 - h. Full Load Percent Slip
 - i. Efficiency at 100%, 75% and 50% Load
 - j. Power Factor at 100%, 75% and 50% Load
2. When specified, noise test shall be performed in accordance with IEEE standard 85 decibel.
3. When specified, water immersion test shall be performed in accordance with NEMA MG 1-20.48.
4. Five (5) copies of certified test reports shall be submitted to the purchaser upon completion of all required tests.
5. Purchaser reserves the right to witness any or all of the tests specified to be performed. Prices for this shall be included as a separate item in the seller's quotation.
6. Motor Vibration: Shall not exceed 0.08 inches/second velocity.

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Q. Submittal Data

1. Required with Proposal
 - a. Preliminary Dimension Print and Frame Size
 - b. Approximate Motor Weight
 - c. Complete Motor Nameplate Information
 - d. Motor Performance Data, including the following:
2. Guaranteed minimum efficiencies at 100%, 75%, and 50% of full load.
3. Guaranteed minimum power factor at 100%, 75%, and 50% of full load.
4. Locked Rotor Current
5. Full Load Current
6. Starting Torque
7. Full Load Torque
8. Breakdown Torque
 - a. Complete description of testing facilities.
 - b. Job site storage requirements.
9. Required within 6 weeks of purchase order award:
 - a. Certified Dimension Prints
 - b. Recommended Spare Parts List Priced
10. Required within motor upon shipment:
 - a. Operation and Maintenance (O&M) Manuals
 - b. Connection Diagrams
 - c. Test Reports as Specified

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- R. Acceptable Manufacturers: Motors shall be U.S. Electrical Motors' "TITAN Line" or pre-approved equal.

2.11 INVERTER AND/OR HOSTILE DUTY TEFC NEMA DESIGN A OR B MOTORS

- A. This section covers inverter duty, continuous rated, horizontal, 3 phase, integral horsepower, TEFC, squirrel cage, AC induction motors in NEMA frame sizes 143-447, 600 volts and below for Variable Frequency Drive (VFD) or Full voltage, across-the-line starting.

1. Service Conditions: Unless otherwise specified, motors conforming to this section shall be suitable for operation in accordance with their rating under the service conditions.

- B. Voltage and Frequency:

1. Standard motors shall be dual voltage through 405 frame and single voltage 444 frame and above. Motors will be rated for operation on 3 phase, VFD power supply.
2. Motors shall operate successfully under running conditions at rated load with variation in the voltage or the frequency not exceeding the following conditions:
- a. +/- 10% rated voltage at rated constant volts/hertz ratio except for specific torque boost situations.
 - b. Motors shall operate successfully under running conditions at rated load and volts/hertz ratio when the voltage unbalance at the motor terminals does not exceed one percent.

- C. Operating Characteristics: With rated volts/hertz ratio applied, motor performance shall be as follows for critical operating characteristics:

1. Torques: Motors shall meet or exceed the minimum locked rotor (starting) and breakdown torques specified in NEMA Standard MG1 Part 12 for Design B for the rating specified when on sine wave power

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2. Currents: Locked rotor (starting) currents shall not exceed NEMA Design B values for the specified rating on 5:1 constant torque or less and variable torque motors. NEMA Design A values are allowed for 6:1 constant torque or higher value constant torque rated motors. Motors shall be capable of a 20-second stall at six times full load current without injurious heating to motor components.
 3. Efficiency: Motors 600 volts and below shall have a nameplate minimum and nominal full load efficiency, which will meet or exceed the values listed in Table 1 for motors when tested in accordance with NEMA Standard MG1 Part 12, IEEE Test Procedure 112 Method B, using accuracy improvement by segregated loss determination including stray load loss measurements.
 4. Temperature Rise: The temperature rise, by resistance, shall be 80° C or less when measured at rated load on sine wave power, on inverter power ratings shall be 105° or less.
- D. Service Factor and Ambient: Standard motors shall be rated for a 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40° C ambient.
- E. Insulation: Standard motors shall utilize the U.S. Electrical Motors' Inverter Grade insulation system, which consists of at a minimum Class F or better insulation materials with additional phase insulating material, extra end-turn bracing a Class H spike resistant wire. The resultant system shall withstand 2000-volt transients without premature motor failure and have no cable limitations in motor application. Standard motors shall be given U.S. Electrical Motors' Insulife 2000 an additional insulation treatment to increase moisture resistance.
- F. Frame Size: The horsepower to frame relationship shall conform to the latest NEMA MG 13 Standard for T frame motors for frames 143 – 447 frames. 10:1 constant torque speed range motors may exceed frame standard by one frame rating. All motors 600 volts and below 182 – 447 frame shall be capable of field modification of NEMA F1 to F2 mounting assembly. Motors covered by this specification are 143 – 447 frame sizes.
- G. Enclosure: Motors shall be totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV) construction and convertible for severe environments. Motor frame, end shields, and inner bearing caps shall be cast iron construction. Conduit box and fan cover may be of steel construction but with field modifiable kits for cast iron fan cover and conduit box on 182 – 447 frames.

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- H. Bearings: All motors 250 frame and above shall have fully re-greasable, anti-friction bearings. 140 frame shall be sealed and lubed for life, 180-360 frame shall be double shielded, and 400-440 frame bearings will be open. All motors 182 frame and above shall have cast iron inner bearing caps. All motors shall have a charged lubrication system to inhibit moisture condensation. Standard motors in frames 254-447 shall have extended grease fittings on the opposite drive-end to facilitate re-lubrication. Grease ports shall be located on the periphery of the motor end shield. Motor shall be fitted with a shaft slinger for a minimum of iP-54 protection.
- I. Ventilating Fans: Shall be corrosion resistant, non-sparking material. All fans shall be suitable for bi-directional rotation.
- J. Conduit Box: Shall be gasketed between the conduit box halves. A grounding provision shall be provided in the conduit box. The conduit box shall be oversize as compared to NEMA requirements and diagonally split and rotatable in 90° increments. The conduit box shall be field convertible to cast iron.
- K. External screws and bolts shall be grade five, hex heads and be plated to resist corrosion.
- L. Motor Shaft: Shall be provided with an external recessed slinger at the drive end of the motor to provide additional (minimum IP-54) protection from moisture and foreign material.
- M. Rotor and stator air gap surfaces shall be coated so as to prevent corrosion.
- N. External Paint: Shall be corrosion resistant – mill and chemical duty paint.
- O. Nameplate: Shall be of stainless steel and stamped per NEMA Standard MG1 Part 10 and Part 31. Nameplate information shall include as a minimum, the nominal efficiency value per NEMA Standard MG1 Part 12, the bearing identification numbers, power factor, torque values with speed range and amps for that torque value. Nameplate also shall include Full Load Slip RPM, magnetizing amps and (if included) encoder PPR and voltage rating.
- P. Motor Vibration: Shall not exceed .08 inches/second velocity.
- Q. For VFD driven motors 100 hp and greater, provide insulated bearing at one end and shaft grounding ring at other end. For motors less than 100 hp, provide a shaft grounding ring at either end of motor.

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- R. Noise Levels: Sound pressure levels shall be average expected values in accordance with values listed in Table 1. Sound pressure dBA shall be measured in a free field with average reading at 3 feet.
- S. Tests: Tests shall be performed on each design to assure compliance with the critical design criteria of this specification for inverter duty motors. Encoder tests, if included, all encoders shall be tested after assembly to the motor. Testing shall include verification of complete quadrature output and index pulse at a full range of speed.

2.12 SUBMERSIBLE ELECTRIC WELL MOTORS

- A. Motor:
 - 1. The motor shall be constructed of material suitable for their application from the standpoints of corrosion resistance and mechanical performance.
 - 2. The motor shall be of the squirrel-cage induction type, suitable for across-the-line starting, designed to directly couple to the bottom of the pump utilizing a NEMA flange. It shall be capable of continuous operation under water at the specified conditions.
 - 3. The motor shall be designed for water-filling, water-cooling, and water lubrication. Oil or grease lubricated motors are not acceptable.
 - 4. The stator shall be hermetically sealed canned type consisting of a core of resin-impregnated windings within a watertight stainless steel enclosure.
 - 5. The motor shall be filled with a mixture of water and propylene glycol, equipped with a diaphragm for pressure equalization, and a check valve to allow water into the motor.
 - 6. The motor temperature shall be rated no higher than the allowable operating temperature of the motor thrust, radial bearings, and upthrust bearings and in no case shall it exceed the temperature rating of the insulation class used to wind the motor.
 - 7. The bearings shall be of ample capacity to carry the weight of all parts plus the maximum hydraulic thrust generated by the submersible vertical turbine pump.

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ELECTRIC MOTORS

8. Suitable precautions shall be taken to restrict sand, silt, or foreign material from entering the motor.
9. The maximum motor diameter and the minimum inside diameter of the well's conductor casing shall be in such relationship that under any operating condition the water velocity past the motor does not exceed 12 ft. per second and not less than 0.5 ft. per second.
10. Motors to have service factor of 1.15.
11. Where Design B, high inrush, type motors are provided, pump vendor shall submit for approval prior to Bidding. Where these motors are furnished, pump vendor is to coordinate with electrical equipment vendor. Failure to do so will be fully at cost of Contractor at no cost to Owner.

B. Submersible Motor Power Cable

1. Pump cable shall be sized to limit the voltage drop to no more than 3%. The flat cable shall consist of three (3) or more separate insulated conductors, plus a ground or a single flat cable assembly consisting of three (3) or more insulating conductors, plus a ground. Each conductor shall be insulated by plastic insulation or synthetic rubber suitable for continuous immersion in water.
2. Individual conductors and/or cable assembly must be jacketed with an oil- and-water resistant synthetic rubber, metal, or other suitable mechanically protective material.
3. The flat cable shall have sufficient conductor area to meet the ICEA code for operation in air. The connecting electrical cable from the starting equipment to the surface plate shall comply with local codes or the National Electric Code, whichever governs.
4. The flat cable shall be secured to the column pipe at 10-foot intervals with stainless steel clamps and rubber or polymer material bushings. Provide shop drawing for Engineer's approval.
5. For every 50 feet of setting, 3 foot of extra flat cable shall be supplied plus an additional 10 feet beyond the surface plate shall be supplied.

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ELECTRIC MOTORS

6. The electrical conductors shall be protected by a corrosion resistant mechanical shield where they pass the pump bowl.
7. All cable fittings and terminals shall be watertight at the pressure encountered in use.
8. Cables shall not be spliced from point of entry into motor to point of exit at well head.

2.13 SUBMERSIBLE LIFT PUMP MOTORS

- A. Power Cable: Multiple power cables for lift pump motors that have parallel conductors less than size 1/0 are not acceptable unless specifically approved by Engineer in writing.
- B. Control Cables: Control conductors shall be an integral part of a single power/control cable assembly. A separate control cable is only acceptable where specifically approved by Engineer in writing.
- C. Conduit for Multiple Cable Assembly: Where a multi-cable assembly is acceptable, Contractor shall provide all additional conduits, pull boxes, and appurtenances required at no additional cost to Owner.

PART 3 EXECUTION

3.00 GENERAL

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.
- B. Energize motor heater while motor is stored on job site. After installation, motor heater shall remain energized at all times. See Item 1.04 – “Quality Assurance” of this specification section for additional requirements.

3.01 ALIGNMENT

- A. Contractor furnishing motor shall be responsible for alignment.
- B. Check alignment of motors prior to startup.
- C. Motors over 50 hp shall have alignment and balance checked using test equipment specially designed for this purpose.

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ELECTRIC MOTORS

3.02 TESTING

- A. Before connecting motor to power source, Meg test each conductor and motor. Record results for Engineer's review.
- B. After energizing motor, measure load current of each phase leg for start and run conditions. Where multiple motors, start all sequentially smallest to largest and record in-rush for each step. Record measurements and submit for Engineer's review.
- C. Verify measurements are acceptable before energizing motor.
- D. For VFD driven motors:
 - 1. Test installation for presence of VFD induced shaft current by use of oscilloscope and provide correct action as required to resolve objectionable conditions.
 - 2. Measure motor voltage at terminals for presence of objectionable VFD induced voltage spikes using an oscilloscope.
 - 3. Where objectionable conditions exist, provide wave form recordings for Engineer's review.

3.03 GROUNDING

- A. Provide bare copper grounding grid buried or under concrete slabs and loop to all motors and electrically operated equipment. Refer to Specification Section 16452 – "Grounding" for additional requirements.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SUMMARY

- A. Section Includes:
 - 1. Identification of electrical materials, equipment, and installations.
 - 2. Nameplate identification on MCC’s and control panels.
 - 3. Arc Flash Warning Signs
 - 4. Equipment and High Voltage Warning Signs
 - 5. Identification of conduit and conductors.

1.02 SUBMITTALS

- A. Submit all products covered under this specification for Engineer’s approval.
- B. Product Data: Submit for each type of product specified.
- C. Samples: Submit for each color, lettering style, and or graphic representation required for identification materials; samples of labels and signs.
- D. Miscellaneous: Schedule of identification nomenclature to be used for identification signs and labels.
- E. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

B. Comply with ANSI C2.

PART 2 PRODUCTS

2.01 RACEWAY AND CABLE LABELS

- A. Manufacturer's Standard Products:** Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

- B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.**

1. Color: Black legend on orange field.

2. Legend: Indicates voltage.

- C. Pre-tensioned, Wraparound Plastic Sleeves:** Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

1. Provide identification wire marker for all power and control conductors.

- D. Colored Adhesive Tape:** Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. wide for phase and ground conductor identification.

- E. Underground Line Warning Tape:** Permanent, bright colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6 in. wide by 4 mils thick.

2. Compounded for permanent direct burial service.

3. Embedded continuous metallic strip or core.

4. Printed Legend: Indicates type of underground line.

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- F. Tape Markers: Vinyl or vinyl cloth, self adhesive, wraparound type with preprinted numbers and letters. Limited use for indoor control cabinets.
- G. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 in. (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- H. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- I. Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 in. (0.05 mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.
- J. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 in. by 0.05 in. for conduit and power conductor identification. Attached with stainless steel bands.

2.02 ENGRAVED NAMEPLATES AND SIGNS

- A. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.
- B. Engraving stock, melamine plastic laminate, 1/16 in. (1.6 mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 in. (3.2 mm) thick for larger sizes.
 - 1. Engraved Legend: Black letters on white face.
 - 2. Punched for mechanical fasteners or stainless steel screws.
 - 3. Use in control panels, MCC's, device housings, boxes, and similar locations.
- C. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 in. (6.4 mm) grommets in corners for mounting.
- D. Exterior, Metal Backed, Butyrate Signs: Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396 in. (1 mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. (6.4 mm) grommets in corners for mounting.

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- E. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.
- F. Exterior, Painted Aluminum, Warning Signs: Wear resistant, non-fading, pre-printed aluminum with glossy finish with colors, and size appropriate to applications, ¼ inch grommets in corners for mounting. Provide per standards ANSI 2535 and OSHA 1910.145.

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1 piece, self-locking, Type 6/6 nylon cable ties with following features:
 - 1. Minimum Width: 3/16 inch
 - 2. Tensile Strength: 50-pound minimum.
 - 3. Temperature Range: -40°F to 185°F.
 - 4. Color: As indicated where used for color coding.
- B. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

2.04 MOTOR CONTROL CENTERS AND CONTROL PANELS

- A. Wire Markers: Provide wire markers on all power and wiring in MCC's and panels of all types. Identify wire at points of termination at devices and at terminal strips.
- B. Provide nameplates on body or housing of all pressure switches, transmitters, and other devices.
- C. Provide engraved nameplates near base of all relays and similar devices. Adhesive materials not allowed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install identification devices according to manufacturer's written instructions.
- B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

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- C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- E. Self-Adhesive Identification Products: Not allowed. Use stainless steel screws.
- F. Identify feeders over 600 V with "DANGER-HIGH VOLTAGE" in black letters 2 in. (51 mm) high, stenciled with paint at 10 ft (3 m) intervals over continuous, painted orange background. Identify following:
 - 1. Entire floor area directly above conduits running beneath and within 12 in. (305 mm) of basement or ground floor that is in contact with earth or is framed above un-excavated space.
 - 2. Wall surfaces directly external to conduits concealed within wall.
 - 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.
 - 4. Entire surface of exposed conduits.
- G. Install painted identification as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.
 - 3. Apply one intermediate and one finish coat of silicone alkyd enamel.
 - 4. Apply primer and finish materials according to manufacturer's instructions.

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ELECTRICAL IDENTIFICATION

- H. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of systems listed below for identification.
 - 1. Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each color band 2 in. (51 mm) wide, completely encircling conduit, and place adjacent bands of 2 color markings in contact, side by side.
 - 2. Locate bands at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft (7.6 m) in congested areas.
 - 3. Colors: As follows:
 - a. Fire Alarm System: Red.
 - b. Fire Suppression Supervisory and Control System: Red and yellow.
 - c. Combined Fire Alarm and Security System: Red and blue.
 - d. Security System: Blue and yellow.
 - e. Mechanical and Electrical Supervisory System: Green and blue.
 - f. Telecommunications System: Green and yellow.
- I. Install Caution Signs for Enclosures: Use label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover with stainless screws.
- J. Install Circuit Identification Labels on Boxes: Label externally as follows:
 - 1. Exposed Boxes: Plastic label on cover.
 - 2. Concealed Boxes: Plasticized card stock tags.
 - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- K. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16 in. (400 mm), use single line marker.

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1. Install line marker for underground wiring, both direct buried and in raceway.
- L. Color Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.
 1. Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.
 - a. Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 in. (150 mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1 in. (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
 - b. Colored cable ties applied in groups of three (3) ties of specified color to each wire at each terminal or splice point starting 3 in. (76 mm) from terminal and spaced 3 in. (76 mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

<u>System Voltage</u>	<u>A.....</u>	<u>B.....</u>	<u>C.....</u>	<u>Neutral</u>
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange.....	Blue	White
277/480 Volt 3Ph/4w	Brown.....	Purple	Yellow.....	Grey
Motor Control	1.....	Black		
	2.....	Red		
	3.....	Blue		
Ground			Green

- M. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.
 1. Legend: 1/4 in. (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Fasten tags with nylon cable ties; fasten bands using integral ears.

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- N. Conduit Identification: Use aluminum tags with SS bands at termination points such as MCC, light fixtures, control panels, receptacles and junction boxes. Tag is to include conduit tag and panel circuit number (where applicable.).
- O. Apply identification to conductors as follows:
 - 1. Conductors to Be Extended in Future: Indicate source and circuit numbers.
 - 2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
 - 3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape.
- P. Apply warning, caution, and instruction signs and stencils as follows:
 - 1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 - 2. Install warning signs on the following equipment as a minimum requirement.
 - a. MCC Main Breaker
 - b. Main Service Breaker
 - c. Transfer Switch
 - d. Where exposed bus bars inside.
 - e. Automatic Power Factor Correction Units
 - f. VFD's and Solidstate Starters
 - g. Other locations described in No. 1 above.
 - 3. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, and/or emergency operations.

Q. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal control, and alarm systems, unless units are specified with their own self-explanatory identification.

Except as otherwise indicated, provide single line of text with ½ inch high lettering on 1 ½ inch high label; where two (2) lines of text are required, use ½ inch lettering on 2 inch high label. For small control panels a smaller text may be used but shall be clearly readable. Use black lettering on white field. Use red lettering on white field where shown on plans or as requested by Engineer or Owner. Apply labels with stainless screws for each unit of following categories of equipment.

- a. Panelboards, electrical cabinets, and enclosures
- b. Access doors and panels for concealed electrical items
- c. Electrical switchgear and switchboards
- d. Electrical substations
- e. Motor control centers and control panels
- f. Motor starters
- g. Push button stations
- h. Power transfer equipment
- i. Contactors
- j. Remote controlled switches
- k. Dimmers
- l. Control devices
- m. Transformers
- n. Inverters
- o. Rectifiers

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ELECTRICAL IDENTIFICATION

- p. Frequency converters
 - q. Battery racks
 - r. Power generating units
 - s. Telephone equipment
 - t. Conduits at manholes, at junction boxes, and pull boxes
- 2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
 - 3. For control panels the nameplate designation shall be according to the control, alarm or status function indicated on the control diagrams, one-line diagrams, details as required in other applicable specifications for this project.
 - 4. Provide nameplate designations list and nameplate and text size for Engineer and/or Owner's approval as required by 1.02 of this specification.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

SECTION 16290

LOW VOLTAGE SURGE PROTECTION DEVICE

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment conforms to the requirements of this project before purchase. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work”, Item 1.04 – “Submittals” for submittal requirements.
- D. All equipment installed on this project shall incorporate all devices and features to protect that equipment from the influence of other equipment, line voltage and phase irregularities, harmonics and other disturbances that may affect the proper and safe operation of that equipment whether these required features are a standard component of that equipment as an off-the-line product. No equipment shall be installed without these features. All surge protective devices shall be provided by same manufacturer.
- E. Contractor shall contact SPD manufacturer’s local representative before bidding to confirm model number supplied is proper for this project application.

1.01 SUMMARY REQUIREMENTS

- A. The Contractor shall furnish and install Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, or models specified as specified herein. The AC surge protection shall be integrated into each of the following items in this project: Electrical distribution equipment, Main breaker, switchgear, transfer switches, switchboards, panelboards, motor control centers, solid-state starters, VFD’s and local control panels, including equipment vendor control panels. This provision may not appear on all drawings, but is required unless specifically noted otherwise.

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

1.02 REFERENCE STANDARDS AND PUBLICATIONS

A. General: The latest edition of the following standards and publications shall comply with the work of this section:

1. ANSI/IEEE C84.1, American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz)
2. ANSI/IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits
3. ANSI/IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
4. Underwriters Laboratories-UL 1449 Third Edition, Standard for Safety - Surge Protective Devices
5. Underwriters Laboratories-UL 1283, Standard for Safety - Electromagnetic Interference Filters
6. National Fire Protection Association, NFPA 70 - National Electrical Code
7. IEEE Standard 142, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)
8. ANSI/IEEE Standard 141, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)
9. IEEE Standard 1100, IEEE Recommended Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)
10. National Electrical Manufacturer's Association, NEMA LS-1
11. MIL Standard 220B Method of Insertion-loss Measurement
12. ISO 9001, Quality Management Requirements

1.03 MANUFACTURER QUALIFICATIONS

A. Eaton shall be the basis of design. All products submitted shall comply with, meet, or exceed the specifications of the Eaton model type specified herein. Equal products as pre-approved in writing by Engineer are acceptable.

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

- B. The manufacturer must be regularly engaged in the manufacture of surge suppression products for the specified categories for no less than 10 years.
- C. For the equipment specified herein, the Manufacturer shall be ISO 9001 or 9002 certified.
- D. The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- E. The surge protection device shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.04 WARRANTY

- A. Contractor shall provide full 10-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin on date of written “Final Acceptance” of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor’s warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer’s products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its affect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor’s expense and at no additional cost to the Owner.
- B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

- C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.
- D. A surge protection device that shows evidence of failure or incorrect operation during the warranty period shall be replaced free of charge. Since “Acts of Nature” or similar statements typically include the threat of lightning to which the surge protection devices shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. The warranty shall cover the replacement of complete device. Surge protection devices with warranties that are meant to repair or supply replaceable parts shall not apply to this section

1.05 SUBMITTALS

- A. The SPD submittals shall include, but shall not be limited to, the following information:
 - 1. Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths.
 - 2. Manufacturer’s certified test data indicating the ability of the product to meet or exceed requirements of this specification.
 - 3. The SPD manufacturer’s local representative shall confirm, in writing, that the SPD model purchased is the proper selection for this project application as indicated on plans and specifications.
 - 4. List and detail all protection systems such as fuses, disconnecting means and protective materials.
 - 5. Surge protection device wiring, bonding, and grounding connections shall be indicated on the wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.
 - 6. If requested, a sample of each suppressor type shall be submitted for use in testing and evaluation.

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7. Provide verification that the surge protection device complies with the required ANSI/UL 1449, Third Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL website, as long as the website contains the following information at a minimum: model number, surge protection device type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
 8. Provide Electrical drawings showing unit dimensions, weights, installation instruction details, lead length configuration, wiring configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.
 9. Wiring diagram for each surge protector.
 10. MOV ratings.
- B. Provide submittals per Specification Section 16012 – “Electrical Work,” Item 1.04, for Engineer's review and approval.
- C. The following information shall be submitted for record purposes:
1. Final As-Built drawings and information for items listed above and shall incorporate all changes made during the manufacturing process.
 2. Provide As-Built Drawings per Specification Section 16012- “Electrical Work,” Item 1.05.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Equipment shall be handled and stored in accordance with Manufacturer's instructions. One (1) copy of Manufacturer's instructions shall be included with the equipment at time of shipment.
- 1.07 OPERATION AND MAINTENANCE (O&M) MANUALS
- A. O&M manuals shall be provided with each surge protection device shipped per Specification Section 16012 “Electrical Work,” Item 1.05.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Cutler-Hammer
- B. Pre-approved equal

2.02 SYSTEM APPLICATION

- A. Only apply a wye (three-phase, four-wire) configured SPD if the neutral is physically connected to the SPD and properly installed per NEC. Confirm with manufacturer.
- B. Use a delta (three-phase, three-wire) configured SPD for any type of impedance (resistive, inductive) grounded system. Confirm with manufacturer.
- C. Use a delta (three-phase, three-wire) configured SPD for a solidly grounded wye system where the neutral wire is not pulled through to the SPD location. Confirm with manufacturer.
- D. Use a delta (three-phase, three-wire) configured SPD if the presence of a neutral wire is not known. Confirm with manufacturer.
- E. The surge protection device applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All surge protection devices shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- F. **Surge Protection Device Type: All surge protection devices installed on the line side of the service entrance disconnect shall be Type 1 surge protection devices. All surge protection devices installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 surge protection devices.**
- G. **Surge protection devices should not be installed on the load (at motor) of any variable frequency drive. Surge protection devices with EMI/RFI filters are not to be used on the load side (at motor) of soft starters.**

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

2.03 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. Surge current per phase – 250 KA/phase for service entrance, 120 KA/phase for panelboards or other locations with 150 amps or more. Provide lower KA/phase ratings only where specifically shown on drawings, or recommended by manufacturer.
4. The suppression system shall incorporate self protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells or air gaps.
5. Protection Modes – The surge protection device must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

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6. Nominal Discharge Current (In) – All surge protection devices applied to the distribution system shall have a 20kA nominal discharge current rating regardless of their surge protection device type (includes Types 1 and 2) or operating voltage. Surge protection devices having a nominal discharge current less than 20kA shall be rejected.

B. Surge Protection Device Design:

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable surge protection device modules shall not be accepted.
2. Electrical Noise Filter – Where specifically indicated on plans, unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted. Noise filter shall not be used for VFD driven motor applications.
3. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
4. Monitoring Diagnostics – Each surge protection device shall provide the following integral monitoring options:
 - a. Protection Status Indicators - Each unit shall have a green / red solid state indicator light that reports the status of the protection on each phase.

C. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes.

1. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

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2. Overcurrent Protection: The unit shall contain self protected MOVs. These self protected MOVs shall have a self protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The self protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
3. Fully Integrated Component Design – All of the surge protection device components and diagnostics shall be contained within one discrete assembly. Surge protection devices or individual surge protection device modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
4. Safety Requirements:
 - a. The surge protection device shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. Surge protection devices containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. Surge protection devices requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. Surge protection devices requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
 - b. Surge protection devices designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
 - c. Side mount surge protection devices shall be factory sealed in order to prevent access to the inside of the unit. Side mount surge protection devices shall have factory-installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.04 ENCLOSURES

- A. All indoor enclosed equipment shall have NEMA 1 general-purpose enclosures, unless otherwise noted, otherwise provide enclosures suitable for locations as indicated in Specification Section 16012 – “Electrical Work,” Item 2.01, Paragraph C or on the

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

drawings, and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure.
3. NEMA 4X – Constructed of 316 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION/INSPECTION

- A. The Manufacturer shall submit a written statement indicating that a factory authorized representative has inspected the installation. The installing contractor shall submit a checkout memorandum to the manufacturers. The memorandum shall indicate the date the equipment is placed into service and the actual method of installation. Submit three copies to the specifying engineer.
- B. Inspection is to be performed prior to energizing SPD's.
- C. The installation of surge protection devices within or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment, and shall not damage equipment or SPD.
- D. SPDs shall use a separate path to building ground where specifically shown on plans; the equipment safety ground is not to be used as the primary transient voltage ground path.
- E. The installing contractor shall install the parallel surge protection device with short and straight conductors as practically possible.

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

- F. The contractor shall follow the Surge Protection Device Manufacturer's recommended installation practice as found in the equipment installation instructions, and as directed by the manufacturer and representative in writing.
- G. The installation shall adhere to all applicable codes.
- H. Route fail alarm circuits to autodialer and to PLC where shown on plans.
- I. The installing contractor of low-voltage lightning arresters shall be knowledgeable, and if required, certified, in all applicable electrical practices, standards, codes and wiring techniques as they pertain to installing surge suppressors.
- J. The installing contractor shall follow all applicable safety standards.
- K. The installing contractor shall follow manufacturer's installation instructions.
- L. The installing contractor shall mount surge protection device devices to keep phase neutral and ground conductor as short as possible and free of sharp bends in conductors. Phase conductors to be equal length. Installer shall make corrections to installation as directed by Engineer.
- M. Where SPD unit is installed at circuit breakers with adjustable GFI trip, contractor shall adjust trip setting at level that prevents false trips due to current flow to ground thru the SPD unit. Provide before and after trip setting values for Engineers review.

3.02 INSTALLATION REQUIREMENTS

- A. The surge protection device application covered under this section includes lighting, distribution panelboards, switchgear, switchboard, MCC and busway locations. The surge protection device units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B and C environments.
 - 1. The surge protection device shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - 2. Surge protection devices shall be installed immediately following the load side of the main disconnect device. Surge protection devices installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 - 3. The panelboard shall be capable of re-energizing upon removal of the surge protection device.

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LOW VOLTAGE SURGE PROTECTION DEVICE (SPD)

4. The surge protection device shall be interfaced to the panelboard via a direct bus bar connection. Alternately, a surge protection device connected to a circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the surge protection device. The surge protection device shall be located directly adjacent to the circuit breaker.
 5. The surge protection device shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 6. The complete panelboard including the surge protection device shall be UL67 listed.
 7. The surge protection device shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer.
 8. The surge protection device shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
 9. All monitoring and diagnostic features shall be visible from the front of the equipment.
- B. Sidemount Mounting Applications Installation (surge protection device mounted external to electrical assembly)
1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices. Phase conductors shall be twisted per manufacturer's requirements.

3.03 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

END OF SECTION

SECTION 16401
ELECTRIC SERVICE

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Section 16012 - “Electrical Work,” Item 1.07 – “Contractor’s Responsibilities” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Existing power company pad mounted service transformer to remain at present location.
- D. Information in this section is general in nature and may not apply to all conditions.

1.01 SUMMARY

- A. Electric Utility Charges: Electric Utility charges for extension of distribution system to point of service termination and meters will be paid by Owner, except where bid allowance is indicated, or where specifically noted otherwise on plans or in other specifications.
- B. Temporary service disconnects at existing installations shall be paid for by Contractor. Prompt connection or reconnection of service shall be coordinated by Contractor. All temporary disconnection and reconnection costs are to be paid for by Contractor.

1.02 DEFINITIONS

- A. Electric Utility: Local Electric Power Company.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA): NFPA No. 70-93 - National Electrical Code (NEC).

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

ELECTRIC SERVICE

B. Power Company Standards:

1. Installation shall strictly comply with current Power Company standards. Where plans conflict with Power Company standards, contact Engineer for directions before starting work. Failure to do so is at Contractor's risk.

PART 2 PRODUCTS

2.00 ELECTRIC SERVICE

A. Electric Service Characteristics:

1. As indicated on Drawings and provided by Electric Utility. Standard voltage is as follows:
 - a. 480/277 volt, 3 phase, 4 wire
 - b. 120/240 volt, 3 phase 4 wire
 - c. 120/240 volt, single phase, 3 wire
 - d. Or as shown otherwise.
2. Where 480-volt delta service is specifically shown on plans, adjust electrical wiring and select all devices to accommodate that type service. Where 12,470-volt primary service is provided, select all devices to accommodate that type service.
3. All 480/277 volt service 200 amps and under, where the service conductors feeds through the meter shall have a disconnect switch installed upstream of the meter per Power Company standards. This requirement is essential and may be shown on plans. CT cans are required for service above 200 amp.
4. Allow for aerial or underground service equipment in bid as determined by Power Company. Most stringent requirements shall be provided at no additional cost to Owner.
5. Do not route aerial service drop across site. Contact Engineer if problem.

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ELECTRIC SERVICE

- B. Service Pole Location: Locate service pole based on “Outlet Location Data Statement” and drawing from Power Company. Do not install service pole or service equipment without this data statement and without confirming location with Power Company and Engineer.

Contact Engineer prior to construction. Provide submittal with layout of Power Company’s pole, Owner’s service pole or rack, control panel or MCC or control building for review by owner, Engineer and Power Company before starting construction. Send copy of Power Company “Outlet Location Data Statement” to Engineer for review. Any construction performed without Engineer’s review is at Contractor’s risk and expense.

- C. All bus weatherhead installations shall have approved insulated split closure plate around entering conductors from Power Company drop to prevent entry of birds or animals into bus weatherhead assembly. Install EYS seals in conduits from weather head above to equipment below.
- D. Provide pad mounted transformer service equipment, conduits and devices where only U.G. or pad mounted transformer service is available from Power Company.

PART 3 EXECUTION

3.00 PREPARATION

- A. Confirmation of Electric Service:
1. Consult with Electric Utility to verify service information specified and shown on Drawings. Failure to do so may result in removal and replacement of service equipment at Contractor’s cost. Do not start service installation work until “Outlet Location Data Statement” has been received from Power Company and has been reviewed and approved in writing by the Engineer.
 2. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements. Send drawing of final service arrangement for engineer’s review. Do not install service equipment until approved by Power Company in writing.

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3. Relocate service pole, transformer pad or structure up to (10) ten feet to maintain clearance required by Electric Utility Company or to maintain other clearances. Coordinate exact point of service with Power Company and locate customer service pole within distance of Power Company pole as per Power Company Standards. Failure to coordinate location is at expense of Contractor and at no additional cost to Owner.

B. Metering:

1. Consult with Electric Utility regarding service entrance requirements and metering equipment. Conform strictly to Utility Company standards.
2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.
3. Consult with electric utility regarding arrangement of disconnect switch in relation to meter, meter can, or other service equipment.
4. Where 480 volt meter is used and a manual transfer switch is used, install one (1) disconnect switch above meter and one (1) below meter per Power Company requirements.
5. See Item 2.01 – “Electric Service,” for meter installation requirements.

C. Application for Electric Service. **(Not applicable for this project)**

1. Obtain required forms from Electric Utility.
2. Assist Owner in completion of forms and deliver completed forms to Electric Utility. Advise Owner of exact voltage and phase requirements.
3. Coordinate schedule for installation of electric service with Electric Utility.
4. Notify utility company in writing, within 30 days of project start date that permanent service will be required for this project. Specify date required and location of project.
5. Notify Owner and Engineer, in writing of date service applied for, date to be installed, Power Company contact name and telephone number and copy of “Outlet Location Data” report as this information become available.

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ELECTRIC SERVICE

Do not start construction of service without this report and without confirming service location with Engineer.

6. Notify Power Company when old abandoned service is to be disconnected. Coordinate with Owner.
7. Contractor is responsible to see that service is connected according to the Power Company standards. Final permanent service connection by Power Company is required before project is considered complete, before final acceptance, and before final payment is made.

END OF SECTION

SECTION 16402
UNDERGROUND DUCTBANKS

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Ductbanks and underground pull boxes shown on plans are assumed worst case site conditions. Locations, quantities and routing may be adjusted to facilitate installation per N.E.C.

1.01 SECTION INCLUDES

- A. Underground electrical duct banks.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B.

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer’s approval.
- B. Catalog cut sheets of the ducts and spacers.
- C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

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UNDERGROUND DUCTBANKS

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling.
- B. Clearly mark packages or crates stating that the material is for electrical duct banks only.

PART 2 PRODUCTS

2.00 ACCEPTABLE MANUFACTURERS

- A. Thomas and Betts.
- B. Underground Devices Inc.
- C. Walker Division, Butler Manufacturing Company.
- D. Carlon
- E. Or approved equal

PART 3 MATERIALS AND EQUIPMENT

- 3.00 Conduit: Construct ducts using schedule 80 rigid PVC conduit. Refer to Section 16111 – “Conduit, Fittings, and Bodies.”
- 3.01 Spacers: Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements.
- 3.02 Concrete: Use steel reinforced, red concrete as duct encasement. Provide Class F concrete in non-truck traffic areas. Provide Class C concrete under gravel or asphalt driveways subject to heavy traffic.
- 3.03 Where unprotected service conductors are routed through a pull box with other conductors a divider wall shall be provided in the pull box for separation as required by the NEC.

PART 4 EXECUTION

4.00 PREPARATION

- A. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities. Adjust route of electrical conduits and ductbanks below proposed or existing buried piping. Provide minimum 24-inch clearance vertically and horizontally. This work shall be performed in a satisfactory manner and at no additional cost to Owner.
- A. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work.
- B. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete.
- C. Be prepared for inspection of the duct banks before reinforcing rod is installed.
- D. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware.
- E. Provide 24-hour notice to Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

4.01 EXCAVATION AND BACKFILL

- A. All underground conduits shall be buried to a minimum depth of 24-inches below finished grade. All trenches shall be uniform width and shall be backfilled and compacted to 95 percent that of original density. Any damage to underground conduits caused by other Contractor's shall be repaired by this Contractor and shall be compensated accordingly by the party or parties responsible for the damage. Concrete shall be poured evenly on all sides of ductbanks. Do not over pour and do not dump spoils on site.
- B. Do not cut paved driveways, sidewalks, etc. Bore under such construction, maintaining a minimum of 24 inches below the underside of the pavement or concrete.
- C. All underground duct banks require inspection prior to concrete pour and inspection prior to covering the concrete. Contact the Inspector, or if not available, contact the Engineer for inspections. Schedule minimum 48 hours in advance.

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UNDERGROUND DUCTBANKS

Any duct banks not inspected will be required to be exposed for inspection by Engineer regardless of status of concrete slabs or foundations.

4.02 INSTALLATION

- A. All underground conduit routing on site plan shall be followed as close as practical. Do not route conduits diagonally across property unless clearly shown as such or, with Engineer's written approval. Any conduits added or changed shall be indicated to Engineer on marked up drawing and submitted for approval. Any unauthorized changes shall be corrected at Contractor's expense, regardless of time discovered by Engineer and, in which case existing concrete shall not be cut or damaged but, shall be replaced in its entirety as shown on the plans as new construction. Do not route underground conduits in conflict with structures or obstructions.
- B. Allow in bid for relocation of underground conduits up to 20 feet to avoid obstructions shown on all other drawings issued under this contract. Coordinate prior to installation of conduits.
- C. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project.
- D. Make duct bank installations and penetrations through foundation walls watertight.
- E. Assemble ductbanks using non-magnetic saddles, spacers, and separators. Position separators to provide 3-inch minimum concrete separation between the outer surfaces of the conduits.
- F. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 pounds per cubic yard to concrete used for envelopes for easy identification during subsequent excavation.
- G. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.
- H. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.
- I. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

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UNDERGROUND DUCTBANKS

- J. Make bends of 30 degrees or more using rigid galvanized steel.
- K. Reinforce duct banks throughout, where indicated on the Drawings.
 - 1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 5 tie-bars transversely placed at 18-inch maximum longitudinal intervals.
 - 2. Maintain a maximum clearance of 3 inches from bars to the edge of the concrete encasement.
- L. Where ducts enter structures such as handholes, manholes, pull boxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Myers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.
- M. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or prevent adequate compaction of fill.
- N. Install a bare stranded copper duct bank ground on top of duct bank. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system.
- O. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Re-pull the rag or sponge swab until the swab emerges clean.
- P. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.
- Q. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 – “Electrical Identification.”

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UNDERGROUND DUCTBANKS

- R. For manholes and pull boxes below grade, install racks to support cables properly around the perimeter and keep them dry. Arrange cables in orderly fashion and tie to racks. If metallic racks are used, provide grounding per NEC.
- S. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings.
- T. All manhole and U.G. pull boxes used for electrical construction are to have the work “Electrical” permanently embossed on cover.
- U. Conduits penetrating underground pull boxes shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon based sealant where smaller than 1 ½-inch diameter.
- V. Conduits penetrating structural walls of lower levels shall be sealed with CSBE seals where larger than 1 ¼-inch diameter and with RTV silicon based sealant where smaller than 1 ½-inch diameter.
- W. All conduit duct banks penetrating lower level structures and penetrating underground pull boxes shall be sealed watertight between conduit and wall of structure or pull box.
- X. Install identification tags on all conduits at manholes, pull boxes, and junction boxes.
- Y. Conduits shall be separated by means of manufactured interlocking “chairs” spaced at no more than 5 feet apart along the length of the ductbank. Spacing between conduits shall not be less than 3 inches.
- Z. Every effort shall be made to minimize the number of bends in all ductbank systems. Field bends shall be made using a “hot box” designed for the size of PVC used. Care shall be given to ductbank routing so that very large radius sweeping turns are designed into the route as opposed to factory made 45° and 90° bends. When factory 90° bends are used, they shall be a minimum of 36-inch radius for 4 inch and 48-inch radius for 5 inch. Factory 90° bends used in ductbank construction shall be rigid metal conduit (ferrous) only. These factory made bends shall be protected by corrosion tape such as 3M Scotchrap 50 or approved equal prior to the concrete pour.
- AA. The ductbank support “chairs” shall be spaced up from the bottom of the trench using cement brick to insure that the proper amount of concrete is poured under the conduits. Sides of the trench may be used as the form if the width does not exceed 1 ½ times the recommended dimension of the ductbank (width.)

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UNDERGROUND DUCTBANKS

- BB. The Electrician shall vacuum, swab, and install pull strings in every conduit of the completed ductbank. The pull string shall be permanently marked in 1-foot increments to aid in wire estimation on future projects. Use Greenlee #435 pull string or approved equal.
- CC. Route all electrical ductbanks and conduits below water lines. Maintain minimum of 24 inches between bottom of water line and top of ductbank.
- DD. Electrical ductbanks are not required below concrete floors of buildings or below process equipment slabs, at which locations conduits shall be encased in minimum 3 inches of stabilized sand. Where ductbanks are shown on plans to be routed under existing concrete slabs or pavements, install per plan details. Do not cut rebar in existing conduit except where approved by Engineer. Repair any cut or damaged rebar by welding back together after conduits are installed. Submit detail of intent for cutting or removal of existing concrete for ductbank installation to Engineer for approval.
- EE. A fish wire shall be left in all conduits in which the permanent wiring is not installed.

END OF SECTION

SECTION 16410
POWER FACTOR CORRECTION

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Section 16012 “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Refer to drawing details for mounting requirements.
- D. Install capacitors on all motors over 5 horsepower. Where motor starter is a solidstate device, provide contactor mounted to MCC bus activated by starter with time delay relay indicator and HOA switch. Provide circuit breaker at bus for overcurrent protection. Provide this requirement whether shown on plans or not.

1.01 SUMMARY

- A. Section Includes: Power factor correction equipment.

1.02 SUBMITTALS

- A. Submit the following for Engineer’s approval.
- B. Product Data:
 - 1. Include data on features, components, ratings, and performance.
 - 2. Include calculations or motor data schedules used to determine capacitor size for each motor 5 horsepower and greater. Provide correction to minimum 0.96 and in no case greater than 0.99. Motors less than 25 horsepower with greater than 0.9 power factor and with solidstate soft starters do not require correction.
 - 3. Provide detail of location and mounting method for Engineer’s approval of location.
- C. Operating and Maintenance Data (O&M):

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POWER FACTOR CORRECTION

1. Maintenance data for system and products for inclusion in Operating and Maintenance Manual.
 - a. List of spare parts and replacement components recommended being stored at site for ready access.
 - b. Detailed operating instructions covering operation under both normal and abnormal conditions.
- D. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exceptions” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.
- B. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- C. Regulatory Requirements:
 1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.04 MAINTENANCE

- A. Extra Materials:
 1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to Owner.
 2. Fuses: Ten (10) of each type and rating.
 3. Blown Fuse Indicating Lamps: Ten (10) lamps of each type and rating.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

POWER FACTOR CORRECTION

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

- A. Environmental Conditions: Equipment withstands following environmental conditions while in operation without mechanical or electrical damage or degradation of operating capability:

1. Ambient Temperature: Minus 20°C to plus 40°C.
2. Altitude: Sea level to 500 ft.

2.02 CAPACITORS, GENERAL

- A. Manufacturers:

1. Power Factor Correction Capacitors – General Use:
 - a. Aerovox.
 - b. ARCO Electric Products Corp.
 - c. Myron Zucker, Inc.
 - d. Square D Co.
 - e. Cutler Hammer
 - f. Siemens
 - g. Or approved equal
2. Power Factor Correction Capacitor – Tray Mount:
 - a. Tray mount by Myron Zucker Inc., for specific MCC Manufacturer.
 - b. Pre-approved equal.

- B. Capacitors: Comply with UL 819 and applicable requirements of NEMA CP1 and IEEE 18.

- C. Construction: Multiple capacitor cells or elements wired together in 3-phase groups and mounted in metal enclosures.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

POWER FACTOR CORRECTION

- D. Capacitor Cells: Dry metalized dielectric, self-healing type. Each cell is encapsulated in thermosetting resin inside plastic container.
- E. Cell Rupture Protection: Equip each cell with an NRTL recognized pressure-sensitive interrupter.
- F. Fuses for Protection of Capacitor Banks: Current-limiting, non-interchangeable type, factory-installed in each phase and located within equipment enclosure. Features include:
 - 1. Interrupting Capacity: 200,000 amperes.
 - 2. Fuse Ratings and Characteristics: As recommended by manufacturer for specific capacitor bank protected.
 - 3. Blown Fuse Indicator: Neon lamps for each fuse, connected to light when fuse has opened, and visible from outside enclosure.
- G. Enclosure: Steel or aluminum, arranged to contain fluid leakage from capacitor cells. Factory-equip with mounting brackets suitable for type of mounting indicated.
 - 1. Indoor Enclosures: Dust-tight or as indicated.
 - 2. Outdoor Enclosures: Gasketed doors or covers and equipped with watertight conduit connections.
 - 3. MCC tray mount in bucket spaces mounting required where MCC is used. Provide additional MCC sections as required.

2.03 FIXED CAPACITORS

- A. Integrally fused except as indicated, with quantities, ratings, mounting provisions and electrical connections as indicated.
- B. Discharge Resistors: Factory-installed and -wired.
- C. Internal Wiring: Completely factory-wired, ready for field connection to external circuits at single set of pressure terminals.

2.04 FACTORY FINISH

- A. Finish: Manufacturer's standard enamel over corrosion-resistant treatment or primer coat.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

POWER FACTOR CORRECTION

2.05 SOURCE QUALITY CONTROL

- A. Factory-test power factor correction equipment prior to shipment. Include following:
 - 1. Routine capacitor production tests, including short-time overvoltage test, capacitance test, leak test, and dissipation factor test.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mount equipment as indicated. Do not mount over top of motor control centers or switchgear.
- B. Install fixed tray mount style capacitors in MCC bucket space near associated motor starter. Where MCC not used, install wall mount style capacitors with stainless steel brackets.
 - 1. Connect on line side of motor starter overload elements and switch with motor.
 - 2. Install fuse holders and fuses within capacitor enclosures.
- C. Maintain minimum working space at live parts according to manufacturer's written instructions.
- D. Install capacitor one (1) each motor, 5 horsepower and above.
- E. Provide contactor with circuit protection device, H.O.A. and time delay relay for capacitors connected to main power bus for solid-state starters. Do not connect capacitors directly to motor or on the load side of starter where solid-state or VFD starters are installed. Contractor shall shunt capacitor on MCC bus.
- F. Provide drawing and detail of each capacitor installation and submit for Engineers approval of location and method of installation.

3.02 IDENTIFICATION

- A. Identify components according to Section 16195 – “Electrical Identification.”

3.03 FIELD QUALITY CONTROL

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

POWER FACTOR CORRECTION

- A. Testing: Test system functions, operations, and protective features according to manufacturer's written instructions.
- B. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- C. Measure power factor with appropriate instruments and provide report to Engineer for evaluation.

3.04 CLEANING

- A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

END OF SECTION

SECTION 16452
GROUNDING

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SUMMARY

- A. Section includes:
 - 1. Solid grounding of electrical systems and equipment.
 - 2. Basic requirements for grounding for protection of life, equipment, circuits, and systems.
 - 3. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B3 - Standard Specification for Soft or Annealed Copper Wire.
 - 2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 3. B33 - Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
 - 4. E699 - Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components.
- B. National Fire Protection Association (NFPA): NFPA 780 – Standard for the Installation of Lightning Protection Systems.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS
GROUNDING

- C. Underwriter's Laboratories (UL): 467 - UL Standard for Safety Grounding and Bonding Equipment.

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer's approval.
- B. Test Results: Report of field tests and observations certified by Contractor.
- C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

- A. Items provided under this section shall be listed OR labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 - 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 - 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:
 - 1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with current NEC. Where types, sizes, ratings, and quantities indicated are in excess of current NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

2.02 WIRE AND CABLE CONDUCTORS

- A. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Assembly of Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.

2.03 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inch wide, except as indicated.

2.04 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for materials used.
- B. Pressure Connectors: High-conductivity-plated units.
- C. Bolted Clamps: Heavy-duty units listed for application.
- D. Exothermic Welded Connections: Provide in kit form and select for specific types, sizes, and combinations of conductors and other items to be connected.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
 - 1. Size: 3/4 inch by 20 feet unless otherwise indicated.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

- 2. Exothermic welded connections only.
- B. Plate Electrodes: Copper plates, minimum 0.10 in. thick, size as indicated.

PART 3 EXECUTION

3.01 APPLICATION

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
 - 1. Install separate insulated equipment grounding conductors with circuit conductors.
 - a. Raceway shall not be used as equipment ground conductor unless specifically permitted or shown on plans.
 - b. Install insulated equipment ground conductor in nonmetallic raceways unless designated for telephone or data cables.
- B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.
- C. Signal and Communications: For telephone, alarm, instrumentation and communication systems, provide #4 AWG minimum green insulated copper conductor in raceway from grounding electrode system to each terminal cabinet or central equipment location.
- D. Ground separately derived systems required by NEC to be grounded in accordance with NEC Paragraph 250-30.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to grounding electrode as indicated on plans in addition to separate equipment grounding conductor run with supply branch circuit.
- F. Connections to Lightning Protection System: Bond grounding conductors or grounding conductor conduits to lightning protection down conductors or grounding conductors in compliance with NFPA 780. Use exothermic connections.
- G. Common Ground Bonding With Lightning Protection System:
 - 1. Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode, using exothermic welded connection.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

- 2. Use bonding conductor sized same as system ground conductor and installed in conduit.
 - H. At all water, wastewater and industrial facilities, install UFER grounding per Item 3.02 – “Installation” at all equipment structures and buildings unless specifically deleted.
 - I. Bond all metallic fences, gates, posts, steel structural columns, and other exposed steel structures.
 - J. Install ground rod at all outdoor control panels, transformers, service racks, equipment enclosures, equipment racks, radio towers, steel canopy structures, and other steel structures where electrical equipment is installed.
 - K. Ground all motor frames using bar copper conductor grid looped to all motors and terminating at ground rods via exothermic connection.
- 3.02 INSTALLATION
- A. General: Ground electrical systems and equipment in accordance with current NEC requirements except where Drawings or Specifications exceed NEC requirements.
 - B. Ground Rods:
 - 1. Locate minimum of one-rod length from each other and at least same distance from any other grounding electrode.
 - 2. Interconnect ground rods with bare conductors buried at least 24 in. below grade.
 - 3. Connect bare-cable ground conductors to ground rods by means of exothermic welds.
 - 4. Make connections without damaging copper coating or exposing steel.
 - 5. Use 3/4-inch by 20-ft. ground rods except as otherwise indicated.
 - 6. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated. Do not locate where obstructing standing or walk space.
 - 7. Install a minimum of two ground rods for motor and equipment grounding grids. Locate at opposite ends of grid loop.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

- C. Metallic Water Service Pipe:
 - 1. Provide insulated copper ground conductors, sized as indicated, in conduit from building main service equipment, or ground bus, to main metallic water service entrances to building.
 - 2. Connect ground conductors to street side of main metallic water service pipes by means of ground clamps.
 - 3. Bond ground conductor conduit to conductor at each end.
- D. Braided-Type Bonding Jumpers: Use elsewhere for flexible bonding and grounding connections.
- E. Route grounding conductors along shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- F. Test Wells: Where “test well” are specifically shown on plans, locate as indicated, and fabricate in accordance with details indicated.
- G. UFER Ground:
 - 1. Fabricate with 20 feet of bare 2/0 (minimum) copper conductor laid lengthwise in excavation for foundation or footings.
 - 2. Install so conductor is within 2 in. of bottom of concrete.
 - 3. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation.
 - 4. Bond conductor to reinforcing steel at four locations, minimum. Bond to all electrical equipment.
 - 5. Extend conductor below grade and connect to building grounding grid or grounding electrode.
 - 6. Extend to all steel support columns for buildings, equipment structures or roof columns.
 - 7. Alternate UFER Grounding: Install 2/0 (minimum) bare copper conductor in 24” deep trench around perimeter of structures, buildings, slabs, and foundations where electrical or mechanical equipment is located.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

Install 4 ft. from edge of structure. Bond to all steel structure and equipment and to grounding system, using exothermic welded connections.

8. Do not install ground grid conductors in or under existing concrete adjacent to generators electrical equipment without written approval from Engineer.

H. Surge Protection Device (SPD) Grounding:

1. Route SPD ground conductor directly to driven ground rod. Route with minimum possible bends in conduits. Do not ground SPD's to ground bus at MCC only.

3.03 CONNECTIONS

A. General: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Aluminum to steel connections: stainless steel separators and mechanical clamps.
4. Aluminum to galvanized steel connections: tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections involving dissimilar metals with inert material such as red paint to prevent future penetration of moisture to contact surfaces.

B. Exothermic Welded Connections:

1. Use for connections to ground rods, structural steel, water tanks, motors, ground grids, electrical/mechanical equipment, generators and enclosures, and for underground connections, except those at electrodes specifically designated on plans as "test wells".
2. Install at connections to ground rods and plate electrodes.
3. Comply with manufacturer's written recommendations. Use CAD-Weld or approved equal.
4. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

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GROUNDING

C. Terminations:

1. Terminate insulated equipment grounding conductors for feeders and branch circuits with approved pressure-type grounding lugs.
2. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to housing, terminate each conduit with grounding bushing.
3. Connect grounding bushings with bare grounding conductor to ground bus in housing.
4. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
5. Do not use metallic housing or mounting plates for ground path to other circuits.

D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A-486B.

E. Connections at "Test Wells": Refer to plan details for connections between conductors and ground rods only, where specifically noted. Otherwise, use exothermic well connections, where specifically designated as test well on plans.

F. Compression-Type Connections: Where compression type connections are specifically called for on plans, use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on ground conductor.

G. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 OVERHEAD LINE GROUNDING

A. General: Comply with ANSI C2, "National Electrical Safety Code" for "Single-Grounded Systems," using two or more electrodes in parallel if single electrode resistance to ground exceeds 25 ohms.

B. Ground Rod Connections: Use exothermic welds for underground connections and connections to rods.

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GROUNDING

- C. Lightning Arresters: Separate arrester grounds from other ground conductors.
- D. Secondary Neutral and Tank of Transformer: Interconnect and connect to ground.
- E. Grounding Conductor Protection: Protect grounding conductors running on surface of wood poles with molding of a type manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces.

3.05 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes:
 - 1. Install 3/4-inch by 20-ft. driven ground rod in corner close to wall and set rod depth such that 4 inches will extend above finished floor.
 - 2. Where necessary, install ground rod before manhole is placed and provide No. 1/0 bare tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall, unless specifically shown otherwise on plans.
 - 3. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 in. above to 6 in. below concrete.
 - 4. Seal floor opening with waterproof non-shrink grout.
- B. Connections at Manholes:
 - 1. Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to ground rod or ground conductor.
 - 2. Make connections with minimum No. 4 AWG stranded hard-drawn copper wire.
 - 3. Train conductors plumb or level around corners and fasten to manhole walls.
 - 4. Connect to cable armor and cable shields by means of tinned terminals soldered to armor or shield, or as recommended by manufacturer of splicing and termination kits.
- C. Grounding System: Ground non-current-carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

3.06 FIELD QUALITY CONTROL

A. Test:

1. Subject completed grounding system to megger test at each location where grounding rod is indicated in plans, including at service disconnect enclosure, surge protection devices, ground terminals, motors, MCCs, electrical equipment, steel structures, and at ground test wells.
2. Measure ground resistance without soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
3. Perform tests by 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."

B. Ground/resistance maximum values shall be as follows:

1. Equipment rated 500 kVA and less: 10 Ohms.
2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.
3. Equipment rated over 1000 kVA: 3 Ohms.
4. Unfenced substations and pad-mounted equipment: 5 Ohms.
5. Manhole grounds: 10 Ohms.

C. Deficiencies: Where ground resistances exceed specified values, drive additional rods (total of three) to achieve acceptable resistance. Notify Engineer after first rod measurement, and if directed by Engineer, provide the additional ground rods to reduce resistance values.

D. Report: Prepare test reports, certified by testing organization, of ground resistance at each test location. Note if additional rods are required as described in item C above. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.07 RESTORATION

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

GROUNDING

- B. Where sod has been removed, replace it as soon as possible after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition.
- D. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.
- E. Restore disturbed paving as indicated.

END OF SECTION

SECTION 16460
TRANSFORMERS

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.01 SUMMARY

- A. Section Includes:
 - 1. General Purpose, Dry Type Transformers.
 - 2. Drive Isolation Transformers.
 - 3. Control and Signal Transformers.
 - 4. Mini Power Zone Packaged Power Supply

1.02 REFERENCES

- A. American National Standards Institute, Inc. /Institute of Electrical and Electronics Engineers (ANSI/IEEE):
 - 1. ANSI/IEEE C2 - National Electrical Safety Code.
 - 2. ANSI/IEEE C57.12.80 Standard Terminology for Power and Distribution Transformers.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA LA 1 - Surge Arresters.
 - 2. NEMA ST 1 - Specialty Transformers (Except General-Purpose Type).
 - 3. NEMA ST 20 - Dry-Type Transformers for General Applications.

- C. Underwriters Laboratories, Inc. (UL):
 - 1. UL 486A- Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 2. UL 506 - Specialty Transformers.

1.03 SUBMITTALS

- A. Submit the following for Engineer's approval.
- B. Product Data:
 - 1. Dimensional plans and sections.
 - 2. Elevations showing minimum clearances.
 - 3. Installed devices.
 - 4. Materials list.
 - 5. Weights.
 - 6. Wiring diagrams.
 - 7. Manufacturer's nameplate data and electrical ratings.
- C. Product Test Reports:
 - 1. Certified copies of manufacturer's design and routine factory tests required by reference standards.
 - 2. Submit after manufacture of transformer and before installation.
- D. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

- A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 - 1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

TRANSFORMERS

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:
 1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
- C. ANSI/IEEE Compliance: Comply with applicable requirements of ANSI/ IEEE standards, including ANSI/IEEE C2 and C57.12.80.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Square D.
- B. General Electric.
- C. Or equal.

2.02 TRANSFORMERS, GENERAL

- A. Transformers:
 1. Factory-assembled and tested, air-cooled units of types specified, having characteristics and ratings as indicated.
 2. Design unit for 60 Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
- D. Internal Coil Connections: Brazed or pressure type.
- E. Bolt coil/core to bottom of enclosure for transformers larger than 15 kVA.
 1. Isolated by rubber, vibration-absorbing mounts.
 2. Metal-to-metal contact between coil/core and enclosure not allowed.
- F. Provide copper windings.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

TRANSFORMERS

- G. Nameplates: Provide metal nameplate listing manufacturer's name, serial number, type, class, kVA voltage, frequency, and showing internal wiring diagram.
- H. Sound Level: Minimum 3 dB less than sound levels for transformer type and size indicated when factory-tested in accordance with NEMA ST 20.
- I. Enclosures at wastewater treatment plant outdoor or chemical area locations to be NEMA 4X stainless steel.

2.03 GENERAL PURPOSE, DRY TYPE TRANSFORMERS

- A. Comply with NEMA ST 20.
- B. Windings: 2-winding type. 3-phase transformers shall use 1 coil/ phase in primary and secondary.
- C. Transformers shall have following features and ratings.
 - 1. Enclosure: Indoor, ventilated unless otherwise shown on plans, outdoor, weather proof unless shown otherwise on plans.
 - 2. Insulation Class: 185°C or 220°C class for transformers 15 kVA or smaller; 220°C class for transformers larger than 15 kVA.
 - 3. Insulation Temperature Rise: 80°C maximum rise above 40°C for 15 kVA and larger; 115°C maximum rise above 40°C below 15 kVA.
 - 4. Taps: For transformers 3 kVA and larger, full capacity taps in high voltage winding as follows.
 - a. 3 through 10 kVA: Two 5% taps below rated high voltage.
 - b. 15 through 500 kVA: Six 2-1/2% taps, 2 above and 4 below rated high voltage.
 - c. 750 through 1,000 kVA: Four 2-1/2% taps, 2 above and 2 below rated high voltage.
- D. Accessories: Following accessory items are required where shown on Drawings.
 - 1. Surge Arresters: Low voltage type, factory-installed and connected to high voltage terminals; complying with NEMA LA 1.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

TRANSFORMERS

2. Wall Mounting Brackets: Manufacturer's standard brackets for transformers sized up to 75 kVA where wall mounting indicated.
3. Electrostatic Shielding: Insulated metallic shield between primary and secondary windings. Connect to terminal marked "shield" for grounding connection, where applicable.

2.04 DRIVE ISOLATION TRANSFORMERS

- A. Comply with requirements of NEMA ST 1 and UL 506, except as specified below.
- B. Ratings:
 1. As indicated and continuous duty.
 2. Minimum kVA: 130% of motor nameplate hp.
- C. Type:
 1. Self-cooled, 2-winding, dry type especially designed for application, with special coil bracing to withstand electro-mechanical forces involved.
 2. 3-ph transformers shall use 1 coil/phase in primary and secondary.
- D. Transformers shall have following features and ratings.
 1. Enclosure: Indoor, ventilated unless otherwise shown on Drawings.
 2. Insulation Class: 220°C class.
 3. Insulation Temperature Rise: 115°C at 115% of rating.
 4. Taps: Two 5% full capacity taps, 1 above and 1 below rated high voltage.
 5. Temperature Sensing Device: Thermistor embedded in coil with leads brought out to terminal board.

2.05 CONTROL AND SIGNAL TRANSFORMERS

- A. Comply with NEMA ST 1 and UL 506.
- B. Ratings:
 1. As indicated and for continuous duty.

- 2. Where rating not indicated, provide 250 percent of load.
 - C. Type: Self-cooled, 2-winding dry type.
 - D. Enclosure: Indoor, except as indicated.
- 2.06 MINI POWER ZONE PACKAGED POWER SUPPLY
- A. Provide with primary breaker, transformer, secondary breaker, and circuit breaker panel as indicated on plans.
 - B. Enclosure shall be NEMA 4X for outdoor and wet area indoor use, NEMA 3R for dry outdoor use, NEMA 1 for dry indoor use, and NEMA 12 for dusty indoor use. Provide stainless steel enclosure where shown on plans.
 - C. Unit shall be rated for maximum full load temperature rise of 115°C.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Arrange equipment to provide adequate spacing for cooling air circulation.
- B. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values not indicated, use those specified in UL 486A and 486B.
- C. Install wall-mounted transformers on prefabricated brackets designed for purpose.
- D. Install floor-mounted transformers on 4-in. concrete housekeeping pad.
- E. Touch up scratched or marred surfaces to match original finish.
- F. Identify transformers as specified herein.
- G. Install lightning arresters as shown on Drawings.

3.02 GROUNDING

- A. Ground in accordance with Section 16452 – “Grounding.”
- B. Ground secondary transformers with separate driven ground rod.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

TRANSFORMERS

3.03 FIELD QUALITY CONTROL

- A. Test and permanently record as follows.
 - 1. Prior to energization of transformers, test phase-to-phase and phase-to-ground insulation resistance levels.
 - 2. Test transformers for continuity of circuits and short-circuits.

3.04 ADJUSTING

- A. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.05 CLEANING

- A. Upon completion of installation, inspect interiors and exteriors of accessible components.
 - 1. Remove paint splatters and other spots, dirt, and construction debris.
 - 2. Touch up scratches and mars of finish to match original.

3.06 PROTECTION

- A. Temporary Heating: Comply with manufacturer's written recommendations within enclosure of each transformer throughout periods during which equipment is not in a space continuously under normal control of temperature and humidity.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

DISCONNECTS AND CIRCUIT BREAKERS

SECTION 16476

DISCONNECTS AND CIRCUIT BREAKERS

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. **Fusible switches are allowed only where specifically shown on Plans for this project, or where approved in writing by Engineer.**

1.01 SUMMARY

- A. Section Includes:
 - 1. Service disconnects.
 - 2. Feeder and equipment disconnects.
 - 3. Enclosed circuit breakers

1.02 SUBMITTALS

- A. Submit the following for Engineer’s approval.
- B. Product Data:
 - 1. Submit for switches, circuit breakers, and accessories.
 - 2. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.
- C. Shop Drawings: Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

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- D. Test Results: Field test reports indicating and interpreting test results.
- E. Operating and Maintenance Data: Maintenance data for tripping devices
- F. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- G. Coordination: Contractor shall determine size, horsepower, voltage, and phase of all equipment and motors supplied and shall adjust breaker and fused switch size accordingly and shall note on submittals. Failure to do so will be at expense of Contractor and at no additional cost to Owner.

1.03 QUALITY ASSURANCE

- A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 - 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 - 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:
 - 1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
- C. Single-Source Responsibility: Enclosed switches and circuit breakers shall be product of single manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fusible Switches:
 - 1. Eaton
 - 2. Cutler-Hammer

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3. Siemens
 4. Or equal, as pre-approved in writing.
 - B. Fused Power Circuit Devices:
 1. Eaton
 2. Boltswitch
 - C. Molded-Case Circuit Breakers:
 1. Eaton
 2. Cutler-Hammer
 - D. Combination Circuit Breaker and Ground Fault Trip:
 1. Eaton
 2. Cutler-Hammer
 - E. Molded-Case Current-Limiting Circuit Breakers:
 1. Eaton
 2. Cutler-Hammer
 - F. Other Manufacturers that are pre-approved in writing.
- 2.02 ENCLOSED SWITCHES
- A. Enclosed Non-fusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks
 - B. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with two (2) padlocks, and interlocked with cover in CLOSED position.
 - C. Enclosed Fusible Switch Larger Than 800 Amperes: Bolted-pressure or high-pressure contact switch, bus drilled to accommodate specified fuses, enclosure consistent with environment where located.
 1. Minimum Fault Current Rating: 100,000 symmetrical rms amperes.

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- D. All enclosures located outdoors or where subject to wet or environmentally harsh locations shall be NEMA 4X 316 stainless steel.
- E. All switches shall be rated at 600 volts minimum.
- F. Handle operator mechanisms shall be on side of enclosure and not on front. Keyed mechanisms that separate handle from breaker mechanism when door is opened are not acceptable.

2.03 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks
- B. Characteristics:
 - 1. Frame size, trip rating, number of poles, and auxiliary devices as indicated
 - 2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amperes minimum
 - 3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.
- C. All enclosures located outdoors or where subject to wet or environmentally harsh locations shall be NEMA 4X 316 stainless steel.

2.04 ACCESSORIES

- A. Solidstate breaker requiring programming unit for settings adjustment
 - 1. Provide new programming unit and all accessories for Owner and Engineers use. Turn over to Engineer for review and testing.
 - 2. Original set-up and adjustments shall be performed by the Circuit Breaker Manufacturers Factory Representative.

2.05 TRIP UNITS

- A. All service and feeder breakers to have replaceable trip plugs, or be adjustable (load current), or be electric type with adjustable trips.

PART 3 EXECUTION

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DISCONNECTS AND CIRCUIT BREAKERS

3.01 INSTALLATION

- A. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.
- B. Install enclosed switches and circuit breakers level and plumb.
- C. Install wiring between enclosed switches and circuit breakers and control/indication devices.
- D. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation.
- B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
- C. Training:
 - 1. Train Owner's maintenance personnel on procedures and schedules for startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 2. Review operating and maintenance data.

3.03 ADJUSTING

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- A. Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.04 CLEANING

- A. After completing system installation including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

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SECTION 16482
MOTOR CONTROL CENTERS (600 VOLTS OR LESS)

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work”, Item 1.04 – “Submittals” for submittal requirements.
- D. Listing of acceptable Equipment Manufacturers does not limit or remove the intent of these specification requirements.**
- E. Provide Power Analysis and Coordination Study using current version of ETAP. Conduct Arc Flash studies and provide Arc Flash warning signs per NEC.

1.01 SUMMARY

- A. Section Includes: Motor Control Centers (MCC’s) for use on ac circuits rated 600 volts or less.
- B. Overcurrent protective devices and disconnect switches used with motor control centers (MCC’s) are specified in Section 16475 – “Overcurrent Protective Devices.”
- C. See Section 16012 – “Electrical Work,” Item 2.01 – “Materials” UL fabrication requirements and Section 16012 – “Electrical Work,” Item 1.04 – “Submittals” for additional submittal requirements.

1.02 REFERENCES

- A. American National Standards Institute (ANSI): ANSI C2-90 - National Electrical Safety Code (NEC).

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- B. International Electrical Testing Association (P.O. Box 687, Morrison, CO 80465): ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250-89 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 2-88 - Industrial Control Devices, Controllers, and Assemblies.
 - 3. NEMA ICS 2.3-88 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
- D. Underwriters Laboratories (UL):
 - 1. UL 486A-89 - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 2. UL 845-89 - Motor Control Centers.

1.03 SUBMITTALS

- A. Submit the following for Engineer's approval.
- B. Shop Drawings:
 - 1. Each MCC including dimensioned plans and elevations and component lists.
 - 2. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.
 - 3. Schedule of features, characteristics, ratings, and factory settings of individual MCC units.
 - 4. Wiring Diagrams: Interconnecting wiring diagrams pertinent to class and type specified for MCC. Schematic diagram of each type of controller unit indicated.
 - 5. Dimensioned floor plans with MCC location and required stub-up entries into MCC. Show all pertinent dimensions that verify MCC fits space allocated on plans. Identify areas where equipment fit is a problem and describe any proposed solutions. All equipment shall be fabricated to fit available space shown.

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- C. Product Data: Each product and component included in MCC (such as VFD) that is described in other specification sections shall be submitted separately or under the MCC cover, and with applicable specification section marked according to requirements of item F below. Submittals received that are incomplete will be returned without review.
- D. Test Results: Certified reports of field tests and observations.
- E. Operations and Maintenance Data: Maintenance data for MCC's.
- F. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- G. Provide one-line diagram with MCC submittal showing actual horsepower of motors to be provided for this project. Do not rely solely on plans but rather, coordinate with other vendors providing motors and equipment. Failure to do so will be at Contractor's expense and at no additional cost to Owner.
- H. All submittals for motor control centers, control panels, control sections, SCADA panels, lift pump panels, and Vendor furnished panels must contain statement of U.L. certification and identifying name and number of U.L. certification.

1.04 QUALITY ASSURANCE

- A. Items provided under this section shall be listed and labeled by UL or other nationally recognized Testing Laboratory (NRTL). This includes complete MCC and switchgear assembly, including controls section.
 - 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 - 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:
 - 1. National Electrical Code: Components and installation shall comply with NFPA 70.
- C. Manufacturer's Qualifications: Manufacturer shall be a member of NEMA, regularly engaged in manufacturing LV MCC's complying with requirements of these

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Specifications, and experienced with at least five (5) projects of similar size and scope.

- D. Product Selection for Restricted Space: Drawings indicate minimum dimensions for MCC's including clearances between MCC's and adjacent surfaces and items and are based on types and models indicated. MCC's of other manufacturers having equal performance characteristics and complying with indicated maximum dimensions may be considered.

- E. MCC starters, MCP, and breaker sizes shall be coordinated with motors supplied device and sizes shall be adjusted as required by motor criteria. This especially applies to high efficiency motors.

Provide motor data to MCC Manufacturer at time MCC is ordered to assure coordination of overcurrent protective devices.

- F. Final assembly and mating of control sections or motor control center section shall be performed at facilities within 200 miles of project location. The following final assembly facilities are acceptable:

1. Weimar Manufacturing Co.
2. B.L. Technology, Inc.
3. W.W. Payton
4. Ace Controls
5. Texas Industrial Controls Manufacturing (TICM)
6. Systems, Inc.
7. Control Panel Manufacturers listed in other Specification Sections.

- G. Testing and Startup:

1. All elements of each electrical control system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all testing and startup work with the Owner and Systems Integration Engineer. As a minimum, the testing shall include both a shop test and a field test by the Engineer.

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2. Factory Tests: The electrical controls and all other associated hardware shall be tested via a full simulation at the factory or shop, prior to shipment, to demonstrate that each component is operational and meets the requirements of these specifications.

Manufacturer shall provide test routine program for shop testing of I/O wiring. Test results shall be certified, with written documentation provided to the Engineer upon test completion. Shop testing may be witnessed by the Engineer, who will provide programming at time of testing.

3. Field Tests: All electrical control system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. General Contractor shall provide commission services for entire electrical system. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval.

Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a paragraph-by-paragraph basis. Each test shall be witnessed and signed off by the Contractor and the Engineer upon satisfactory completion. The Contractor shall notify the Owner at least 2 weeks prior to the commencement date of the field tests. After tests are completed and with system fully operational, system shall run continuously for a period of 10 days without failure. Any failures shall be repaired and test shall start over again.

4. Pump Controller Program: Testing will require a minimum of 10 working days after programs are downloaded to the pump controller. Provide 4 weeks' notice for program downloading by Programmer. This shall be accounted for in project schedule.
 5. Prior to testing system, or PLC programs or HMI programs provided by other than the Systems Integration Engineer shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program.
- H. Provide MCC that fits space available. Where dimensions exceed available space, sections are to be relocated in room or, MCC shall be specifically manufactured for this project to accommodate the space restrictions at no additional cost to Owner. Contractor shall contact Engineer before ordering equipment or installing conduits where space restriction exists.
- I. Where controls section is fabricated by other than MCC Manufacturer, a matching

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controls sections shall be provided and shipped to controls fabrication shop at time MCC is ordered so as to expedite controls assembly.

- J. Cabinet and Enclosures Heights: Cabinet, panel, and enclosure heights shall not exceed 6 feet – 6 inches from floor to top fastening devices to allow access by Operator without use of ladders or steps to open enclosure doors.
- K. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in shipping splits of lengths that can be moved past obstructions.
- B. Store so condensation will not occur on or in MCC's. Provide temporary heaters as required to prevent condensation.
- C. Handle MCC's in accordance with NEMA ICS 2.3, "Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory-installed lifting provisions.

1.06 MAINTENANCE

- A. Extra Materials:
 - 1. Spare Fuses: Furnish one spare for every five of each type and rating of fuse and fusible devices installed, but not less than one set of three of each kind. Include spares for:
 - a. Control power circuit breakers.
 - b. Fuses and fusible devices for fused circuit breakers. (Where fuses approved.)
 - c. Fuses for fusible switches. (Where fuses approved.)
 - 2. Spare Indicating Lights: Furnish five of each type installed.

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3. Touch-Up Paint: Furnish three (3) half-pint unopened containers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. Cutler-Hammer
- C. Siemens
- D. Square D.
- E. General Electric
- F. Or equal, as pre-approved in writing before bid date.

2.02 MOTOR-CONTROL CENTERS

- A. Wiring Classification: Class I, Type B, as defined in NEMA ICS 2.
- B. Enclosure: NEMA Type 1, gasketed, as defined in NEMA 250, except as otherwise indicated.
- C. Compartments:
 - 1. Modular, with individual doors with concealed hinges and quick-captive screw fasteners.
 - 2. For combination starter units provide interlocks so disconnect means must be in off position before door can be opened and so door cannot be closed with disconnect means in on position, except by consciously operating permissive release device. Rotating type operators located outside of door are not acceptable.
- D. Interchangeability:
 - 1. Construct compartments so it is possible to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in control center.
 - 2. Units requiring same size compartment shall be interchangeable, and

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compartments shall be constructed to permit ready rearrangement of units such as replacing three single units with unit requiring three spaces without cutting or welding.

- E. Wiring Spaces:
 - 1. Provide each vertical section of structure with horizontal and vertical wiring spaces for wiring to each unit compartment in each section.
 - 2. Provide separate door over vertical wiring space.
 - 3. Provide supports to hold wiring rigidly in place.
- F. Meet current NEC requirements for service entrance.
- G. Ratings: Provide nominal system voltage, continuous main bus amperage, and short time and short-circuit-current ratings as indicated and conform to short circuit and coordination study.
- H. All enclosures for motor starters 100 hp and greater shall have forced air cooling. All outdoor enclosures are to have sufficient forced fan cooling. Provide rain hood, intake louvers, insect screens and fan motor circuits with t-start “On/Off” controls.
- I. Unless specifically noted or shown on plans, all outdoor MCC’s shall be NEMA 4X stainless steel with three (3) point latching doors. Indoor enclosures shall be NEMA 1, unless shown otherwise on plans. Where NEMA 1 enclosure is installed outdoors in a NEMA 3R or 4X outer enclosure, the inner NEMA 1 enclosure shall be independently fabricated and installed, separate from the outer enclosure such that the outer enclosure may be replaced without disturbing the inner enclosure in any manner.
- J. All outdoor enclosures shall have means of cooling and/or ventilation where environmental temperatures exceed any internal device ratings.
- K. All step-in or walk-in enclosures shall have adequate ventilation for cooling.
- L. Door Restraints: Provide door restraints on all doors for outdoor enclosures.
- M. All MCC sections to have 120-volt space heater with t-stat.
- N. All connections to devices and controls external to MCC shall be made at terminal strips on blocks only. Direct connection to MCC devices is prohibited.
- O. Door latches shall not be operated with hex head type screws. Flat blade screwdriver

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shall be able to open latches.

- P. Provide enclosed type fluorescent light fixture in each MCC section. Install switch at location shown on Plans.

2.03 BUSES

- A. Material: Tin plated copper.
- B. Ampacity Ratings: As indicated for horizontal main buses and vertical bus sized for indicated loads or 300A minimum.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Non-insulated, horizontal copper bus 2 inches by ¼ inch, minimum.
- E. Horizontal Bus Arrangement: Extend main phase, neutral and ground buses with same capacity entire length of MCC unless otherwise indicated, and provision for future extension at both ends by means of bolt holes and captive bus splice sections or approved equivalent.
- F. Natural Disconnect Link: For switchgear assembly having main service disconnect. Arrange to permit disconnecting the switchgear assembly neutral bus from the common ground bus and the incoming service neutrals. Also, provide a bolted, un-insulated, ¼ inch x 2 inch copper bus (main bonding jumper). Arrange to interconnect the neutral and the ground buses to establish the system common ground point.
- G. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.
- H. Current transformers shall be mounted with factory brackets in line with bus bar or conductor routing. Provide warning label to deactivate power to MCC before attempting service to C.T.

2.04 FUNCTIONAL FEATURES

- A. General: Provide modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.
- B. Motor Controller Units:
 - 1. Combination controller units; of types and with features, ratings, and circuit

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assignments indicated.

2. Units with full-voltage, across-the-line, magnetic controllers up to and including Size 3 shall be installed on drawout mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions.
3. Units shall have short-circuit current ratings equal to or greater than short-circuit current rating of MCC section.
4. Units in MCC's shall be equipped with pull-apart terminal strips or drawout terminal boards for external control connections.
5. All autotransformer type start installation shall be coordinated with power factor capacitors to avoid resonant conditions that might produce harmonics.
6. All autotransformer type starters to have temperature sensor devices. Connect to controls to protect autotransformer from over-temperature.
7. All well and blower motor starters to have start time delay relay.
8. Contactor shall include minimum of four single pole, double throw spare auxiliary contacts rated at 10 amperes continuous, for each starter furnished.

C. Overcurrent Protective Devices:

1. Provide types of devices with features, ratings, and circuit assignments indicated, as specified in Section 16475 – “Overcurrent Protective Devices.”
2. Individual feeder tap units through 225 ampere rating shall be installed on drawout mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions.
3. All equipment feeder and/or motor circuit breakers (not MCP) are to have plug-in trip unit.
4. Motor Circuit Protectors (MCP) shall be electronic type that learn inrush current and adjust accordingly.

D. Overload Relays:

1. Ambient-compensated type with inverse-time-current characteristic.

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2. Provide with heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle. Overload devices to require manual reset after tripping occurs. Provide trip relay and provide signal circuit to PLC, SCADA, autodialer or annunciator to indicate trip signal.
3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing.
4. Select overload heaters and relays based on Motor Manufacturer's requirements, or based on motor nameplate data, size at 1.15 FLA (nameplate). Measure actual FLA in operation and provide data in O&M Manual. Where overloads trip during normal operation, provide current recordings to analyze cause and time of events, and provide data to Engineer for recommended corrective action.
- E. Coordinate size of circuit breakers, trip units, MCP's and other overcurrent protective devices, with motor manufacturer's and provide proper rated devices accordingly.
- F. Spaces and Blank Units: Compartments fully bussed and equipped with guide rails or equivalent, ready for insertion of drawout units.
- G. Spare Units: Type, sizes, and ratings as indicated, and installed in compartments indicated "spare."
- H. All motor starter controls are to include ETM, HOA, start time delay relay, and Run light as a minimum. Controls shall have HOA switch and circuits that allow automatic restart of controls after momentary power interruption, without rest action required. Lock-in push button controls are not allowed. Provide time delay for restart.
- I. Control Diagrams: Provide complete and accurate control diagrams and one-line diagram laminated in clear plastic and installed in door pockets of motor control center.
- J. All control transformers shall be sized for 250 percent of full load. Provide CPT with 120V secondary and primary circuit breakers. CPT to be rated at minimum of 500VA providing 350VA capacity for loads above controller requirements. Provide secondary circuit breakers for controls and other devices indicated on plans. Do not feed motor heater circuits from starter CPT power source.

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- K. All display screens or readouts shall be mounted in panel at height of 60 inches above level where operator stands. This must be accounted for where panels are installed on concrete pads or other elevated structures.
- L. Inhibit Relays: Where generator is not designed to carry full load of motors, provide inhibit relay for each motor starter over 5 horsepower to inhibit motor starter operation when generator runs. Relay is to be energized by generator run signal from ATS or generator. Provide bypass switch across the inhibit relay contacts to allow selected motors to run on generator power.
- M. Provide one (1) additional auxiliary contact for each motor starter.
- N. Where standard MCC controls section shown on Plans will not contain all devices on backplate, provide additional plate hinged to side of section wall for mounting additional devices. Space location to all clearance from devices on backplate.
- O. Manufacturer to provide all controller addresses, HMI and OIU templates and other data pertinent to SCADA programming by Engineer. No exceptions.
- P. All control device settings are to be adjusted by Contractor for values recommended by the Plant Operator. Contract Engineer for clarifications.
- Q. Controls – Trouble, Failure and Status Indications
 - 1. Control circuit devices shall have auxiliary contacts to indicate position, alarm and status for annunciating a control circuit string condition at any specific time. This string shall include all devices from start of diagram such as HOA switch, control devices, alarm devices, status devices, motor starters, overload relays and circuit breakers, which shall all have status or alarm contacts. Provide circuits from each inputs of PLC controller, SCADA, autodialer or annunciation equipment. This requirement is to allow operator to immediately identify any device or function that may prevent proper operation of electrical system equipment. Refer to control diagrams in places for typical control circuits.

2.05 IDENTIFICATION PRODUCTS

- A. Provide identifying devices.
- B. Equipment Markers: Provide 2-ply, 1/8-in. thick laminated plastic, engraved equipment

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markers.

1. Color: Black letters on white background.
 2. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - a. Equipment name (i.e. motor control center).
 - b. Equipment Tag No. (i.e. 30-MCC-1).
 3. Size: Provide approximate 3-in. by 6-in. (minimum) for equipment.
 - a. 1-in. high letters for equipment tag number.
 - b. 1/2-in. high letters for descriptive equipment name.
 4. Size: Provide approximate 1 ½ inch by 3 inch (minimum) for device or component.
 - a. ¼ inch high letters for equipment tag number.
 - b. ¼ inch high letters for descriptive equipment name.
 5. Fasteners: Self-tapping stainless steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate.
- C. Wire Markers: Provide wire markers for all power and control wiring. Install at points where wire terminates at devices and terminal strip.
- D. Place wire identification tags at each end of all conductors.

2.06 FINISHES

- A. Manufacturer's standard finish suitable for environment in which installed.

2.07 CONCRETE BASES

- A. Class "B" as specified in Part 3 – “Execution.”

PART 3 EXECUTION

3.01 INSTALLATION

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- A. General: Install MCC's in accordance with NEMA ICS 2.3 "Instructions for Handling, Installation, Operation, and Maintenance of MCC's," and with manufacturer's written installation instructions.
- B. Anchor each motor-control center assembly to concrete base in accordance with manufacturer's recommendations. Level and grout sills flush with motor-control center mounting surface.
- C. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from MCC units and components.
- D. Install separate independent anchor bolts for NEMA 1 enclosure where based outdoors with an outer enclosure. Outer enclosure shall be removable without disturbing inner enclosure, as described in Item 2.02 – “Motor Control Centers.”
- E. All components inside enclosures shall be fastened down with proper hardware. All cables shall be bundled and bound with waxed cord or nylon tie-raps manufactured for that purpose. Adhesive tie down blocks are not allowed. Provide threaded press-in or welded studs for nylon cable clamps as required.
- F. Contractor shall coordinate all conduit stub-ups into MCC. Any mis-located conduits shall be relocated at Contractor's expense and at no additional cost to Owner.
- G. All motor control centers shall be fabricated to fit space available as shown on plans, even when special fabrication is required.
- H. Stub up all conduits entering MCC's, and other equipment enclosures from the bottom into each respective starter, feeder breaker or control section per equipment manufacturers conduit layout detail. Coordinate with equipment manufacture data sheets before starting any underground or below slab conduit installations.

3.02 CONCRETE BASES

- A. Provide 4-inch high concrete foundation on pad under MCC or as shown on plans.

3.03 LOCKOUT TAG OUT STATION

- A. Provide and install wall mounted enclosed padlock storage module with hinged door. Module shall have 8 hooks, each capable of holding 2 locks. Provide 8 safety locks and tags. Provide sign on door. Brady or equal quality Manufacturer. Identify field-installed wiring and components and provide warning signs, as specified in Section 16195 –

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“Electrical Identification.”

3.04 CONNECTIONS

- A. Tighten MCC bus joint bolts, electrical connector, and terminal bolts in accordance with Manufacturer's installation instructions and torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

- 1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum of 2 workdays, travel time excluded, for assistance during plant startup, equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of:
 - a. Two (2) person-days for Instructional Services.
- 2. Supplier or Manufacturer shall direct services to specific system and equipment operation, maintenance, and troubleshooting.

B. Testing:

- 1. Comply with applicable requirements of InterNational Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."
- 2. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include record of repairs and adjustments made.
- 3. Perform following tests:
 - a. Test insulation resistance of MCC buses; components; and of connecting supply, feeder, and control circuits. For components with solid-state devices or other sensitive components, perform tests in accordance with manufacturer's instructions.
 - b. Make continuity tests of circuits.
 - c. Inspect MCC's for defects and physical damage, testing laboratory labels,

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- circuit connections, and nameplate compliance with up-to-date system drawings.
- d. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - e. Check MCC anchorage, external clearances, and alignment and fit of components including internal elements.
 - f. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - g. Perform visual and mechanical inspection and related work for motor control and protective devices.
 - h. Device Ratings and Settings: Verify ratings and settings of overload relays, motor circuit protectors, and overcurrent protective devices.
4. Quality Control Testing Program: Assure MCC installation meets specified requirements, is operational within specified tolerances, and provides appropriate protection for systems and equipment.
- a. Test and inspect MCC's in accordance with manufacturer's recommendations and these specifications.
 - b. Schedule tests and provide notification at least 7 days in advance of test commencement.
 - c. Reports: Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and corrective action taken.
 - d. Labeling: On satisfactory completion of tests and related effort, apply label to tested components indicating results, person responsible, and date.
 - e. Test insulation resistance of buses and portions of control wiring that disconnect from solid-state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.
 - f. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformers and

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control power wiring.

g. Check phasing of supply source to bus.

h. Test motor-control devices.

i. Test overcurrent protective devices.

5. Retesting: Correct deficiencies and retest. Verify by retests that specified requirements are met.

3.06 CLEANING

A. Inspect interior and exterior of MCC's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.07 PROTECTION

A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each section of switchgear throughout periods during which the switchgear is not in a space that is continuously under normal control of temperature and humidity.

3.08 WARRANTY

A. Contractor shall provide full 3-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin on date of written "Final Acceptance" of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor's warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed.

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Where Manufacturer's products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its affect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor's expense and at no additional cost to the Owner.

- B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

3.09 TRAINING

- A. Provide minimum eight (8) hours of "hands-on" instruction each for Owner's staff. To be conducted at project site by control systems manufacturer's representative, at no additional cost to Owner. Training is to be conducted after all control systems are fully operational. To include PLCs and other devices. See Section 16012 – "Electrical Work" for additional requirements and refer to other equipment
- B. Provide minimum two (2) weeks notice to Engineer and Owner before conducting training.

END OF SECTION

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ELECTRONIC SOFT-START CONTROLLERS

SECTION 16484
ELECTRONIC SOFT-START CONTROLLERS

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work”, Paragraph 1.04 – “Submittals” for submittal requirements.
- D. Listing of acceptable Equipment Manufacturers does not limit or remove the intent of these specification requirements.**

1.01 SCOPE

- A. This specification describes the electrical, mechanical, and reliability requirements for three phase, electronic soft-start starters (controllers) with full voltage non-reversing (FVNR) bypass contactor as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

- A. Division 16 – “Electrical” that apply to the requirements of this project.

1.03 REFERENCES

- A. The electronic soft-start controllers and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards of IEC, UL, and NEMA.

1.04 SUBMITTALS FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer.
 - 1. Dimensioned outline drawing.

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2. Schematic diagram
3. Component list.
4. Power and control connection diagram(s)

B. Submit six (6) copies of the above information.

C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.05 SUBMITTALS

A. Submit all products covered under this section for Engineer’s approval.

1. Descriptive bulletins
2. Product sheets

B. See Section 16012 – “Electrical Work” for additional requirements.

1.06 SUBMITTALS-FOR CLOSEOUT

A. The following information shall be submitted for record purposes prior to final payment.

1. Final as-built drawings and information for items listed section in 1.04.
2. Installation information

B. See Section 16012 – “Electrical Work” for additional requirements.

C. Refer to Section 16013 – “Electrical Submittals”, and Section 16014 – “O&M Manual”.

1.07 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

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- C. Electronic soft-start controllers shall be equivalent to features of manufacturers listed on Part 2 of this section type for function and quality. Products that comply with the specifications and manufactured by others are acceptable where pre-approved in writing.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Six (6) copies of the equipment operation and maintenance manuals shall be provided.
- B. Operation and maintenance manuals shall include the following information:
 - 1. Step-by-step operation and maintenance instructions
 - 2. Recommended renewal parts list.
 - 3. Drawings and information required by Paragraph 1.06.
 - 4. Comply with O&M requirements of Section 16012 – “Electrical Work.”

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. Cutler-Hammer
- C. Siemens
- D. Or equal, pre-approved, in writing

2.02 SOLID-STATE REDUCED VOLTAGE MOTOR CONTROLLER REQUIREMENTS

A. Electronic Soft-Start Controller with FVNR bypass.

- 1. The solid-state reduced voltage starter shall be UL and NEMA listed. The solid state reduced voltage controller shall be an integrated unit with power SCR's, heat sink, logic board, paralleling bypass contactor, and electronic overload relay

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enclosed in a single molded housing.

2. A full voltage bypass and isolation contactor is to be provided in addition to the standard Run contactor. Bypass contactor is to be NEMA rated and UL listed to start motor across the line.
3. The SCR based power section shall consist of six (6) back-to-back SCR's and shall be rated for a minimum peak inverse voltage rating of 1600 volts PIV. The starter shall be three-phase, 60 Hz, and rated for the hp, current, and voltage as shown on the drawings.
4. Units shall include an integrated fan controlled by thermal sensors on the heat sink. Fan shall automatically operate during the start ramp and if internal temperature on the heat sink exceeds 60 degree C.
5. Units using triacs or SCR/diode combinations shall not be acceptable.
6. Resistor/capacitor snubber networks shall be used to prevent false firing of SCR's due to dv/dt effects.
7. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.
8. The paralleling run bypass contactor shall energize when the motor reaches 90% of full speed and close/open under 1 times motor current.
9. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
10. Starter shall be provided with electronic overload protection as standard and shall be based on an inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIPswitch setting on the device keypad. Overload device trip relay shall provide signal to PLC, SCADA, autodialer and annunciator to show tripped condition.
11. Overload protection shall be adjusted via the device keypad and shall have a motor full load amp adjustment from 30 to 100% (3.2:1) of the max continuous ampere rating of the starter.
12. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIPswitch setting on the device keypad.

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13. Starter shall be capable of either an electronic or mechanical reset after a fault.
14. Units using bi-metal overload relays are not acceptable.
15. Overtemperature protection (on heat sink) shall be standard.
16. Starters shall provide protection against improper line side phase rotations as standard. Starter will shut down if a line side phase rotation other than A-B-C exists. This feature can be disabled via a DIPswitch on the device keypad.
17. Starters shall provide protection against a phase loss as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via a DIPswitch on the device keypad.
18. Start shall provide protection against a motor stall condition during the start ramp as standard. This feature can be disabled via a DIPswitch on the device keypad.
19. Starter shall provide protection against a motor jam condition during run as standard. This feature can be disabled via a DIPswitch on the device keypad.
20. Starter shall be provided with a form C normally open (NO), normally closed (NC) contact that shall change state when a fault conditions exists. Contacts shall be rated 240V AC and 24V DC max, 3 amps as standard. In addition, an LED display on the device keypad shall indicate type of fault (Overtemp, Phase Loss, Jam, Stall, Phase Reversal, and Overload).
21. The following control function adjustments on the device keypad are required:
 - a. Selectable Torque Ramp Start or Current Limit Start
 - b. Adjustable Kick Start Time, 0-2 seconds
 - c. Adjustable Kick Start Torque, 0-85% (of LRT)
 - d. Adjustable Ramp Start Time; 0.5-180 second
 - e. Adjustable Initial Starting Ramp Torque; 0-85% (of LRT)
 - f. Adjustable Smooth Stop Ramp Time; 0-60 seconds.
22. Enclosed units shall include a thermal magnetic circuit breaker or HMCP for short circuit protection and quick disconnect means.

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23. Starters and breakers/HMCP's are to rated per UL508D for a withstand rating of 65 kAIC rms unless shown greater on one-line diagram.
24. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues.
25. The Manufacturer of the solid-state starter shall employ a field based factory service organization for the purpose of startup and repair of units. (Third party service contractors are not acceptable.) Manufacturer's local distributor shall maintain a minimum stock of one of each model unit installed under this contract.
26. Maximum continuous operation shall be at 100% of continuous amp rating.
27. Control power shall be 24V DC as standard for safety and reliability. In addition, provide CPT with 120V secondary and primary circuit breakers. CPT to be rated at minimum of 500VA providing 350VA capacity for loads above controller requirements. Provide secondary circuit breakers for controls and other devices indicated on plans. Do not feed motor heater circuits from starter CPT power source.
28. Separate control terminals shall be provided for 24V DC power, logic level signals for permissive, start, jog forward, ramp start overload override and electric reset.
29. Control terminals shall be pull-apart for easy access and wiring.
30. Optional external interface circuitry shall include 120-volt relay logic interface capability.
31. A removable Customer Interface Module (CIM) shall be provided that allows for full adjustment of control and protection functions thru the use of potentiometers and DIP switches.
32. Power terminations shall consist of pressure type terminals.
33. Enclosure
 - a. Where separate enclosures are shown on plans, enclosures shall not be less than 16-gauge steel. Type 12 enclosures shall be of welded construction with gasketed heat sink and doors.

See plans for alternate enclosure requirements.

- b. The following shall be included:

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- 1) The operating handle of the disconnect, when supplied, shall always remain connected to the breaker or switch. The operating handle shall not be mounted on the door of the enclosure, but on the controller for safe “stand-aside” operation.

The position of the operating handle will indicate ON or OFF position of switch or circuit breaker and include provision for padlocking in the OFF position. Through door mechanisms that have alignment rods are not permitted.
 - 2) Interlock provisions shall prevent unauthorized opening or closing of the starter door with the disconnect in the ON position.
 - 3) The structure, when floor-mounted, shall be provided with adequate lifting means and shall be capable of being rolled or lifted into installation position and bolted to the floor.
34. Controller characteristics shall be coordinated with motor manufacturer’s requirements and/or restrictions for soft-start controller starting and operation.
 35. All enclosures for SSRV motor starters for well and booster pumps shall have solid-state air cooling. All enclosures for any size controller shall have forced fan air filters within enclosure. Where installed in MCC lineup, provide in each starter section.
 36. Controller shall have ethernet, RS232, RS485 and Ethernet com ports for communicating, monitoring, and control interface with pump controller PLC. Provide all software, HMI templates, addresses, and programming in coordination with SCADA Programmer for a complete working control interface. Provide all required factory interface cables. Allow for Ethernet and/or ModBus or ModBus Plus communications protocol with Ethernet via fiber optic link to Master Control Station or to solid-state controller OIU. Provide all software and addresses.
 37. Where Ethernet Fiber Optic (F.O.) communications link is indicated on plans, provide F.O. converter as required to interface controller or SCADA.
 38. Manufacturer to provide all controller addresses, HMI and OIU templates and other data pertinent to SCADA programming by Engineer. No exceptions.
 39. Where power factor correction capacitors are used or shown on plans, a capacitor contactor with a time delay relay, HOA switch and run light shall be used to connect capacitor to main bus. DO NOT connect capacitor across motor or on load side of starter. Contactor shall shunt starter on MCC set time delay such that

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any bypass contactors have transferred to Run before closing capacitor Contractor. Provide documentation of settings for Engineer review.

40. Vendors for equipment with solid-state controller shall include provisions for both hardwired and data path status, command and alarm functions included under contract without additional cost to Owner, Programmer, or Engineer.
41. Contactor shall include minimum of four single pole, double throw spare auxiliary contacts rated at 10 amperes continuous, for each starter furnished.
42. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished.

It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions.

43. Factory Technician shall confirm which manufacturing modes that starter has been adjusted and programmed to operate in before operating motor. Program start and stop ramp time as agreed by Engineer. All well motors are to have extended ramp down when stopping. Coordinate ramp time with Engineer.
44. Controller shall have filters as required to prevent introduction of harmonics on motor power circuit when solid state SCRs are operating motor. Provide factory test data that describes frequency and amplitude of any harmonics for Engineers review.
45. Provide auxiliary contacts on all motor circuit protectors (MCP), motor starter circuit breakers, motor starter overloads, solid state starters, variable speed drive units, MCC feeder breakers, main service breaker, generator main breaker, low voltage transformer primary breakers and other breakers shown with trip units on one-line diagram to show tripped condition. Route trip circuits to solid state controller, SCADA, pump controller, and autodialer inputs for alarm initiation and annunciation. Coordinate with all equipment, MCC, control panel and SCADA suppliers and, with programmers.

PART 3 EXECUTION

3.01 FACTORY TESTING

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- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. All printed circuit boards shall be functionally tested via fault finder bench equipment prior to unit installation.
2. All final assemblies shall be load tested.

3.02 INSTALLATION

- A. Coordinate installation with other trades and install controller according to manufacturer's recommendations.
- B. Where Contractor fails to protect electronic soft start controller before and after installation on site and where excessive dust is observed inside the enclosure, the Contractor shall have a factory warranty service technician clean, inspect and test unit, after which the factory shall issue a written and signed statement that full factory is in effect. There are no exceptions to this requirement except to replace entire unit at Engineer's request.

3.03 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section. The Manufacturer's Representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein. A Factory Technician shall provide all programming and set up adjustments for starter and shall provide a written report for Engineer's review. Report shall include value setting of each and every setting or adjustment for both hardware or software programmers. Engineer must approve operations of motor based on settings or certified by Factory Technician as correct for this project applications.
- B. The following minimum work shall be performed by the Contractor and Manufacturer's Representative under the technical direction of the manufacturer's service representative. Allow for a minimum of twelve (12) days for factory technician including all expenses for the following services:
1. Inspection and final adjustments for startup, and acceptance testing.
 2. Operational and functional test of controllers.

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- 3. Participation in commissioning services. Technical Representative shall be present for duration of commissioning tests related to vendor equipment.
 - C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made. Report shall include all hardware and software adjusted values and dates adjusted.
 - D. Vendors for equipment with solid-state controller shall include provisions for both hardwired and data path status, command and alarm functions included under contract without additional cost to Owner, Programmer, or Engineer.
- 3.04 FIELD ADJUSTMENTS
- A. Make all adjustments according to manufacturer's recommendations. All adjustments and set-up shall be factory trained Technician only. No exceptions.
 - B. Coordinate adjustments of soft-start controller with other equipment adjustments, such as standby power generator.
- 3.05 FIELD TESTING
- A. Factory Technician shall test controller operation in presence of Engineer and/or Owners representative. Testing shall include oscilloscope recording of each phase let to observe any unwanted harmonic wave forms introduced on motor circuit during ramp up or ramp down of motor by the solid state SCR devices.
 - B. Provide field support for testing as required and at times needed with Programmer and Owner's Representative.
 - C. Factory Technician shall be present for final acceptance testing and shall demonstrate system operation to Engineer and Owner's Representative.
- 3.06 MANUFACTURER'S CERTIFICATION
- A. A qualified Factory-Technician shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.
 - B. The Contractor shall provide three (3) copies of the certification and warranty before final payment is made.
- 3.07 TRAINING
- A. The Contractor shall provide a training session for Owner's Representatives at a jobsite location determined by the Owner.

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- B. The training shall be conducted by a Manufacturer's qualified representative.
- C. The training program shall consist of the following:
 - 1. Instructions on the proper maintenance and operation of the equipment
- D. Training, travel and all other expenses shall be at no additional cost to Owner.
- E. See Section 16012 – “Electrical Work” for additional requirements.

3.08 WARRANTY

- A. All equipment and materials provided under the scope of this specification shall include full warranty for a period of 3 years from date of electrical acceptance as described in Specification Section 16012. Full warranty includes all parts, materials, labor and shipping and delivery to jobsite.
- B. Contractor shall provide full 3-year service warranty on the overall installation, and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin at date of written final acceptance of electrical systems and shall include both labor and materials at no additional cost to owner. There are no exceptions to this requirement. Contractors warranty shall guarantee 24-hour service response time and shall provide whatever labor, work, or materials needed to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for over 24 hours from time Owner calls for warranty service. This shall be at no additional cost to Owner. All materials and equipment installed shall have full warranty from manufacturer that guarantees equipment is rated for the harsh Industrial Electrical/Mechanical environment in which it is installed. Where manufacturer's products fail prematurely, manufacturer shall be fully responsible for new replacement and shall not have option of declaring that failures were caused by environment and its affect on the product. Contractor is fully responsible for assuring that product manufacturers are aware of this condition and that manufacturer's warranty statement is included in shop drawings. Failure to do so will be at full expense of Contractor and at no additional cost to Owner. Where warranty requirements are shown in other sections, the more stringent requirement shall have precedence.

END OF SECTION

**SECTION 16510
LIGHTING FIXTURES**

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. **Installation and materials shall comply with local ordinances and illumination requirements.**

1.01 SECTION INCLUDES

- A. Specification for:
 - 1. Fluorescent lighting fixtures
 - 2. High intensity discharge (HID) lighting fixtures
 - 3. Incandescent lighting fixtures
 - 4. Photo cells
 - 5. Light emitting diode (LED) lighting fixtures.

1.02 REFERENCES

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - 1. No. 70 - National Electrical Code (NEC)
 - a. Article 410 - Lighting Fixtures, Lampholders, Lamps and Receptacles
 - 2. No. 101 - Life Safety Code

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- B. American National Standards Institute (ANSI)
 - 1. C78.379 - Electric Lamps - Incandescent and High Intensity discharge Reflector Lamps - Classification of Beam Patterns.
 - 2. C82.4 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 3. C62.41.2 – Transient Surge Requirement for Light Emitting Diode (LED) Systems.
- C. American National Standards Institute/Illuminating Engineering Society (ANSI/IES): The IES Handbook shall be used as a basis for design and construction of lighting systems.
- D. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. /Illuminating Engineering Society (ASHRAE/IES): ASHRAE/IES 90.1 - 1989 - Energy Efficient Design of new Buildings Except Low-Rise Residential Buildings.
- E. American National Standards Institute/Underwriters Laboratories (ANSI/UL).
 - 1. UL1570- Fluorescent Lighting Fixtures.
 - 2. UL1571 - Incandescent Lighting Fixtures.
 - 3. UL1572 - High Intensity Discharge Lighting Fixtures.
 - 4. UL8750 – Light Emitting Diode (LED) Equipment for use in Lighting Products.

1.03 SUBMITTALS

- A. Submit all products covered under this specification for Engineer's approval.
 - 1. Outline dimensions, support points and unit weight.
 - 2. Operation and maintenance data.
 - 3. Complete test report with photometric curves.
 - 4. Storage, handling, and installation recommendation.
 - 5. Connection diagrams.

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6. Catalog data.

- B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- C. Manufacturer’s light fixture and accessories data sheets shall not confirm reference to “Contractor Select”. Data sheets shall have model numbers that correctly identifies fixture and accessories as described and included on plans and in specifications.

1.04 QUALITY ASSURANCE

- A. Tests. Run manufacturer's tests on lighting fixtures in accordance with applicable Underwriters Laboratories (U.L.) Standards 1570, 1571 and 1572.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Have lighting fixtures individually packed to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. As shown on plans.

2.02 REQUIREMENTS

- A. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification.
- B. High-Intensity Discharge (HID) Fixtures
 - 1. Provide fixtures that are High Pressure Sodium (HPS) type.
 - 2. Select fixtures which are enclosed and gasketed with mogul base porcelain lamp socket.
 - 3. Use ballast high power factor type with taps for 120V, 208V, 277V, and 480V input voltage, conforming to ANSI Standard C82.4. Low temperature ballast is required for cold weather operation.

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4. Refer to Drawings or fixture schedules specific types, sizes and mounting hardware.
- C. Incandescent Lighting Fixtures
1. Provide incandescent lighting fixtures with vandal-proof construction.
 2. Fixtures shall be made for wall, ceiling or pendant mount in accordance with the Drawings or fixture schedules.
 3. Fixtures shall be designed for single incandescent lamp, medium base for maximum 150 watts with cast aluminum base and vandal-resistant polycarbonate lens or globe.
 4. For outdoor application the fixtures shall be of vaporproof NEMA 4X construction with globe, guard and stainless steel hardware.
 5. In hazardous areas the fixtures shall be approved under standard UL844 for Class 1, Division 1, Group D environment and shall be equipped with globe, guard and stainless steel hardware.
- D. Fluorescent Ballasts: Electronic integrated circuit, solid-state, full-light-output, energy-efficient type compatible with lamps and lamp combinations to which connected.
1. Certification by Electrical Testing Laboratory (ETL).
 2. Labeling by Certified Ballast Manufacturers Association (CBM).
 3. Type: Class P, high power factor, except as otherwise indicated.
 4. Sound Rating: "A" rating, except as otherwise indicated.
 5. Voltage: Match connected circuits.
 6. Lamp Flicker: Less than 5%.
 7. Minimum Power Factor: 90%.
 8. Total Harmonic Distortion (THD) of Ballast Current: Less than 20%.
 9. Conform to FCC Regulations Part 15, Subpart J for electromagnetic interference.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

LIGHTING FIXTURES

10. Conform to IEEE C62.41, Category A, for resistance to voltage surges for normal and common modes.
11. Multi-lamp Ballasts: Use 2, 3, or 4 lamp ballasts for multi-lamp fixtures where possible.
12. Lamp-ballast connection method does not reduce normal rated life of lamps.
13. Low-Temperature Fluorescent Ballasts: Comply with above requirements, except ballast may be Class P electromagnetic type. Starting temperature is minus 20EC or colder.
14. Ballasts to have fused protection.

E. Photo Cells

1. Provide a photo cell to control outdoor fixtures unless otherwise indicated on the lighting plans.
2. Use a photo cell that is either the plug-in twist-locking type or the wire-in swivel-top type, both with similar features and operating characteristics.
3. Provide a photo cell that is enclosed in a UV-resistant rain-tight polypropylene housing with the cell being a 0.75 square inch cadmium sulfide surface passivated and a single pole, single throw normally closed bi-metallic switch.

F. Light Emitting Diode (LED Lighting Fixtures

1. Fixtures shall be made for wall, ceiling or pendant mount in accordance with the Drawings or fixture schedules.
2. For outdoor application the fixtures shall be of vaporproof NEMA 4X construction with globe, guard and stainless steel hardware.
3. Conform to ANSI/IEEE C62.41.2 for resistance to voltage surges for normal and common modes.

PART 3 EXECUTION

3.01 PREPARATION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

LIGHTING FIXTURES

- A. Check the types and quantity of fixtures to be mounted in the area to be illuminated and verify that materials are on hand.
- B. Provide correct lamps for fixtures along with the necessary accessories and mounting hardware.

3.02 INSTALLATION

- A. Install fixtures in accordance with manufacturer's instructions, NEC Articles 410, 500 and 700 as applicable, and the Drawings.
- B. Wire up fixtures in accordance with the Drawings and ensure proper switching, circuiting and balanced loads.
- C. Make sure proper grounding and bonding are provided for fixtures and raceways.
- D. When applicable, aim and adjust fixtures in accordance with directions as indicated on the Drawings.
- E. Energize and test fixtures for proper operation.
- F. Check illumination level with light meter and ensure that sufficient illumination is covering areas where tasks are performed and confirm egress paths are properly illuminated during emergency situations.

END OF SECTION

SECTION 16525
EXTERIOR LIGHTING

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. **Installation and materials shall comply with local ordinances and illumination requirements.**

1.01 SUMMARY

- A. Section Includes: Exterior lighting fixtures, lamps, ballasts, poles standards, and accessories.

1.02 REFERENCES

- A. American Association of State Highway and Transportation AASHTO LTS-1-Standard Officials (AASHTO). Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C2-90 - National Electrical Safety Code.
 - 2. ANSI C78.1-91 to C78.1502 - Electric Lamps.
 - 3. ANSI C82.2-84 - Fluorescent Lamp Ballast - Method of Measurement.
 - 4. ANSI C82.4-85 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 5. ANSI C136.13-87 - Roadway Lighting - Metal Brackets for Wood Poles.
 - 6. ANSI C136.30 - Roadway Lighting Equipment - Fiber-Reinforced Plastic (FRP) Lighting Poles.

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7. ANSI 05.1-92 - Wood Poles - Specifications and Dimensions.
 - C. American Society for Testing and Materials (ASTM):
 1. ASTM A500 - REV A-90 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 2. ASTM B209-90 - Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate.
 3. ASTM B429-92 - Standard Specifications for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - D. American Wood Preservers Association (AWPA): AWPA C4 - Poles, Preservative Treatment, Pressure Processed.
 - E. Institute of Electrical and Electronic Engineers (IEEE): IEEE C62.41-91-IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - F. Underwriter's Laboratories (UL):
 1. UL 773-87 - UL Standard for Safety Plug-In, Locking Type Photocontrols for Use with Area Lighting.
 2. UL 844-90 - UL Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 3. UL 935-84 - UL Standard for Safety Fluorescent Lamp Ballasts
 4. UL 1029-86 - UL Standard for Safety High-Intensity Discharge Lamp Ballasts.
 5. UL 1570-88 - UL Standard for Safety Fluorescent Lighting Fixtures.
 6. UL 1571-91 - UL Standard for Safety Incandescent Lighting Fixtures.
 7. UL 1572-91 - UL Standard for Safety High Intensity Discharge Lighting Fixtures.
- 1.03 DEFINITIONS
- A. Fixture: Complete lighting unit. Fixtures include lamp or lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.
 - B. Lighting Unit: Fixture, or assembly of fixtures with common support, including pole or

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

EXTERIOR LIGHTING

bracket plus mounting and support accessories.

- C. Luminaire: Fixture.

1.04 SUBMITTALS

- A. Submit the following for Engineer's approval.

- B. Product Data.

1. Describe fixtures, lamps, ballasts, poles, and accessories.
2. Arrange Product Data in order of fixture designation.
3. Include data on features, poles, accessories, and following:
 - a. Outline drawings of fixtures and poles indicating dimensions and principal features.
 - b. Electrical ratings and photometric data with certified results of independent laboratory tests.

- C. Shop Drawings: Detail fixtures and poles and indicating dimensions, weights, methods at field assembly, components, and accessories.

- D. Test Results: Certified reports of field tests and observations.

- E. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

- F. Manufacturer's light fixture and accessories data sheets shall not contain reference to "Contractor Select". Data sheets shall have model numbers that correctly identifies fixture and accessories as described and included on plans and in specifications.

1.05 QUALITY ASSURANCE

- A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

EXTERIOR LIGHTING

2. Terms "listed" and "Labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.
2. Comply with ANSI C2, "National Electrical Safety Code."

C. Fixtures for Hazardous Locations: Conform to UL 844 or get Factory Mutual Engineering and Research Corporation (FM) certification for the class and division of hazard.

D. Manufacturers' Qualifications: Firms experienced in manufacturing lighting units that are similar to those indicated for this Project and that have record of successful in-service performance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Poles:

1. General: Store poles on decay-resistant treated skids at least 1 ft above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.
2. Metal Poles: Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.07 WARRANTY

A. Special Project Warranty: Submit warranty, mutually executed by manufacturer and the Installer, agreeing to replace external parts of lighting fixtures exhibiting failure of finish as specified below. This warranty is in addition to, and not limitation of, other rights and remedies Owner may have under Contract Documents.

1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.
2. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation.
3. Special Project Warranty Period: 5 yrs, beginning on the date of Substantial

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

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Completion.

1.08 MAINTENANCE

A. Extra Materials

1. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to Owner.
 - a. Lamps: 10 lamps for each 100 of each type and rating installed. Furnish at least 1 of each type.
 - b. Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 for each 100 of each type and rating installed. Furnish at least 1 of each type.
 - c. Ballasts: 1 for each 100 of each type and rating installed. Furnish at least 1 of each type.
 - d. Globes and Guards: 1 for each 20 of each type and rating installed. Furnish at least 1 of each type.

PART 2 PRODUCTS

2.01 FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs and sharp edges and corners.
- B. Sheet Metal Components: Corrosion-resistant aluminum, except as indicated. Form and support to prevent warping and sagging.
- C. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed fixtures.
- D. Doors, Frames, and Other Internal Access Provisions: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect ballast.

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EXTERIOR LIGHTING

- E. Exposed Hardware Material: Stainless steel.
- F. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
 - 1. White Surfaces: 85%.
 - 2. Specular Surfaces: 83%.
 - 3. Diffusing Specular Surfaces: 75%.
- G. Plastic Parts: Resistant to yellowing and other changes due to aging and exposure to heat and UV radiation.
- H. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.
- I. Photoelectric Relay: UL 773.
 - 1. Contact Relays: Single-throw, arranged to fail in the "on" position and factory set to turn light unit on at 1.5 to 3 footcandles and off at 4.5 to 10 footcandles with 15 sec' minimum time delay.
 - 2. Relay Mounting: In fixture housing.

2.02 FLUORESCENT FIXTURES

- A. Fixtures: Conform to UL 1570.
- B. Ballasts: Conform to UL 935, certified by Electrical Testing Laboratory (ETL). Labeled by Certified Ballast Manufacturers Association (CBM).
 - 1. Type: High-power factor type rated for -20EC starting and listed for use in outdoor fixtures.
 - 2. Sound Rating: A or B.
 - 3. Voltage: Match connected circuits.
 - 4. Ballasts to have fused protection.
 - 5. Use ballast high power factor type with taps for 120 volt, 208 volt, 277 volt, and 480 volt input voltage, conforming to ANSI Standard C82.4. Low temperature ballast is required for cold weather operation.

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EXTERIOR LIGHTING

2.03 HIGH-INTENSITY DISCHARGE (HID) FIXTURES

- A. Fixtures: Conform to UL 1572.
- B. Ballasts: Conform to UL 1029 and ANSI C82.4; provide constant wattage autotransformer (CWA) or regulating high-power factor type, with taps for 120, 208, 277, and 480 volt unless otherwise indicated.
 - 1. Operating voltage matches system voltage.
 - 2. Single-Lamp Ballasts: Minimum starting temperature of -30°C.
 - 3. Construct ballasts so open circuit operation will not reduce average life.
 - 4. Ballasts to have fused protection.
- C. Instant Re-strike Device: Solid-state potted module, mounted inside fixture and compatible with mogul-based HPS lamps, ballasts, and sockets up to 150 watts.
 - 1. Re-strike ranges: 105 to 130 vac.
 - 2. Output voltage does not exceed 250 v peak or 150 vac RMS.

2.04 INCANDESCENT LIGHTING FIXTURES

- A. Conform to UL 1571.

2.05 FIXTURE SUPPORT COMPONENTS

- A. Pole-Mounted Fixtures: Conform to AASHTO LTS-1.
- B. Wind-Load Strength: 100 mph and 1.3 gust factor for total support assembly, including pole, base, and anchorage, where used, to carry fixtures, supports, and appurtenances at indicated heights above grade without deflection or whipping.
- C. Arm, Bracket, and Tenon Mount Materials: Match the poles.
- D. Mountings, Fastenings, and Appurtenances: Corrosion-resistant components compatible with poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position luminaire to provide indicated light distribution.

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- E. Pole Shafts: As shown on Plans.
- F. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.
- G. Anchor Bolts: Anchor bolt length, orientation, and thread projection shall comply with pole manufacturer recommendations. Plywood (or equal) template shall be used during placement of anchor bolts for correct pole base hole alignment. Finished bolt alignment shall be straight and true.
- H. Steel Poles: Steel tubing conforming to ASTM A500, Grade B, carbon steel with minimum yield of 46,000 psi. Poles are 1-piece construction up to 40 ft in length and have access handhole in wall.
- I. Steel Mast Arms: Fabricated from 2-in. pipe, continuously welded to pole attachment plate and having span and rise as indicated.
- J. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without underbrace, in the sizes and styles indicated, with straight tubular end section to accommodate the fixture.
- K. Pole-Top Tenons: Fabricated to support fixture indicated and securely fastened to the pole top.
- L. Metal Pole Grounding Provisions: Welded 1/2-in. threaded lug, accessible through handhole.

2.06 LAMPS

- A. Conform to ANSI Standards, C78 series, applicable to each type of lamp. Provide fixtures with indicated lamps. Where lamps are not indicated, provide lamps recommended by manufacturer.

2.07 FINISH

- A. Metal Parts: Manufacturer's standard finish except as otherwise indicated. Finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove poles, fixtures, and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.
- B. Other Parts: Manufacturer's standard finish except as otherwise indicated.

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EXTERIOR LIGHTING

2.08 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. HID Fixtures: Conform to UL 1572.
- B. HID Ballasts: Conform to UL 1029 and ANSI C82.4. Include following features, except as otherwise indicated.
 - 1. Constant wattage autotransformer (CWA) or regulating high-power-factor type, unless otherwise indicated.
 - 2. Operating Voltage: Match system voltage.
 - 3. Single-Lamp Ballasts: Minimum starting temperature of minus 30° C.
 - 4. Normal Ambient Operating Temperature: 40°C.
 - 5. Open circuit operation will not reduce average life.
 - 6. Ballasts to have fused protection.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Set units plumb, square, level, and secure according to manufacturer's written instructions and approved submittals.
- B. Provide all required parts, devices, supports, brackets and structural connections needed for complete installation of fixtures. Observe structural conditions and/or Plans to determine exact requirements.

3.02 CONCRETE FOUNDATIONS

- A. Construct concrete foundations with 3,000-lb, 28-day concrete. Foundations shall be sized by Pole/Lighting Manufacturer and designed for 110 mph winds. Dimension and depth shall be per Manufacturer's recommendations. Use Manufacturer's template for setting factory anchor bolts.
- B. Embedded Poles: Set poles to indicated depth, but not less than 1/6 of pole length below finish grade. Dig holes large enough to permit use of tampers full depth of hole. Backfill

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EXTERIOR LIGHTING

in 6-in. layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

- C. Pole Installation: Use fabric web slings (not chain or cable) to raise and set poles.
- D. Fixture Attachment: Fasten to indicated structural supports.
- E. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.
- F. Lamp fixtures with indicated lamps according to manufacturer's instructions. Replace malfunctioning lamps.

3.03 GROUNDING

- A. Ground fixtures and metal poles as specified in Section 16452 – “Grounding”.
 - 1. Poles: Install 10-ft driven ground rod in ground well at each pole.
 - 2. Nonmetallic Poles: Ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor.

3.04 FIELD QUALITY CONTROL

- A. Inspect installed units for damage.
- B. Provide advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source. Include the following:
 - 1. Photometric Tests: Measure light intensities at locations where specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
 - 2. Check for excessively noisy ballasts.
 - 3. Check for uniformity of illuminations.
 - 4. Written report of tests indicating actual illumination results.

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- E. Replace or repair damaged and malfunctioning units and retest.

3.05 ADJUSTING AND CLEANING

- A. Clean components on completion of installation. Use methods and materials recommended by manufacturer.

- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SOUND ATTENUATING ENCLOSURE

SECTION 16622

SOUND ATTENUATING ENCLOSURE

PART 1 GENERAL

1.00 CONDITIONS

- A. This Specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work”, Item 1.04 – “Submittals” for submittal requirements.

1.01 SECTION INCLUDES

- A. **This section specifies furnishing and installing a weatherproof sound attenuating enclosure around the standby emergency power generator, where required by local or state agencies having jurisdiction at location of water plant, and where sound levels may exceed any regulated noise levels.**

1.02 REFERENCE STANDARDS

- A. Furnish and install a weatherproof sound attenuating enclosure designed to reduce the noise level of the standby emergency power generator set equal to applicable Agency requirements, Typically, Agencies require that overall acoustical performance shall reduce the un-silenced noise levels 3 feet from all sides, at 5 feet elevation, and at 3 feet above the enclosure to minimum 84 db or less. In addition, enclosure construction must reduce sound levels at nearest property line or site boundary is not to exceed 70 db(A) adjacent to residential project locations. Adjust elevated steel structure size and capacity accordingly for a specific manufacture as required.
- B. Generator enclosure design shall be able to withstand the following loadings: 120 mph winds, 42 lb. /ft. loads, when properly anchored to steel platform structure.

1.03 RELATED WORK

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SOUND ATTENUATING ENCLOSURE

- A. Division 16 – “Electrical” that apply to the requirements of this project.

1.04 PRODUCT

- A. Construction:

1. Where applicable, general construction of the enclosure walls and roof shall consist of dual wall, prefabricated tongue-and-groove type acoustic panels with a 16 gauge, galvanized steel outer skin; a 22 gauge, perforated galvanized steel inner skin; roll formed internal channel stiffers and framing; and 3 lbs/cu. ft. density mineral glass fiber acoustical/ thermal insulation completely filling the void between the inner and outer skins. Also included shall be a 2 mil mylar protective liner installed between the perforated inner skin and the insulation material. An acoustical labyrinth shall be achieved at each panel joint or seam.
2. The enclosure’s super structure will consist of a structural rectangular tube frame work. The structure shall consist of two full length base members, six full width base members, four full height corner columns, and two full width roof beams. This structure shall be completely seal welded at each connection point and all open tube ends will be capped with seal welded plates. Lifting eyes rated at a safe working load of 8,000 pounds each (for units that weigh more than 6,000 pounds) or 6,000 pounds each (for units that weigh less than 6,000 pounds) shall be installed at the top of each structural tube steel corner column. Anchor bolt clips shall be located and installed along the inside perimeter of the structural tube steel base frame.
3. All doors will be factory mounted in a separate, self-supporting, welded steel frame. All door hardware will be factory mounted.

Door hardware to include 316 stainless steel Component Hardware Group brand refrigeration type slam locks with exit bar, two-point slam and take-up locks with inside release handle, Component Hardware Group, Inc. ball bearing heavy duty hinges, and positive type stainless steel door holders. Doors shall have neoprene or EPDM perimeter gasketing. Door shall seal completely along gasketed perimeter.
4. Acoustical treatment of the cooling air intake and discharge opening shall be achieved with straight-through type, full height vertical baffles. Each baffle shall be of a one-piece construction.

Construction of each baffle shall include a galvanized steel frame and stiffeners,

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

SOUND ATTENUATING ENCLOSURE

perforated galvanized steel skin, roll-formed galvanized steel end caps, and acoustical insulation completely filling the void between the perforated skins. Each baffle must be easily removable to allow for completely open ends. Removal of the baffles shall not affect structural integrity of the enclosure. The baffles shall be located within the overall length of the enclosure's walls and roof. Silencers mounted externally from the enclosure are not acceptable.

5. In addition to the cooling air intake/discharge openings being acoustically treated, a set of 6" deep stationary weather louvers with bird screens shall be supplied. These louvers shall be mounted to the enclosure's structural tube steel frame at each end of the enclosure. Louvers are to be removable and have lifting eyes to aid in removal.
6. Vent fan forced air ventilation with T-STAT and switch, interior lighting with switch, and GFI W.P. receptacle shall be provided and connected to a 12 circuit (minimum) NEMA 1 surface mounted lighting panel complete with 60AT/2P main breaker, (12) 20A (or, as required for loads) plug-in circuit breakers and 15 kVA (or, as shown on plans) encapsulated 480/120-240 volt transformer, located in the enclosure. Contractor to provide feeder circuit from Motor Control Center.
7. Provide approved concrete or steel stairs with landing where required for access from grade level. Provide shop drawings for Engineer's approval.
8. No penetrations shall be made through walls, floor, or top of enclosure by anyone other than the Manufacturer or, unless specifically authorized by Engineer, in writing, after detailed drawing has been submitted. This includes penetrations for fuel lines and conduits. Any unauthorized holes may result in replacement of entire enclosures.
9. All fuel lines to engine are to enter via underground 4-inch Schedule 80 PVC sleeve or via floor through, as indicated on plans.

B. Manufacturers

1. Acceptable manufacturers are:
 - a. SEMCO, Inc.
 - b. Acoustical Control Systems, Inc. (ACS)
 - c. Engine & Compressor Accessories (E&CA)

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

SOUND ATTENUATING ENCLOSURE

- d. Or, as pre-approved in writing.

1.05 SUBMITTALS

- A. Submit all products covered under this specification for Engineer's approval.
- B. Submit the following information to the Engineer for approval prior to placing any equipment on order:
- C. Dimensional Drawings. Submit dimensional drawings of the sound attenuating enclosure and accessories.
- D. Test Report. Furnish a certified copy of the factory test report on the actual enclosure provided.
- E. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install sound attenuating enclosure according to plans and specifications.
- B. Coordinate enclosure door height and swing with canopy elevation.
- C. Enclosure will be installed on elevated steel structure which will require flooring, screening or other means to prevent entry of birds, insects or animals from bottom of enclosure.

3.02 FIELD TESTING

- A. Perform sound level measurements with a calibrated sound level instrument and demonstrate readings in presence of Engineer and Owner's Representative. Record readings on plans and elevation drawing for Owner's record

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

SOUND ATTENUATING ENCLOSURE

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS GENERATOR AND CONTROLS

SECTION 16660

NATURAL GAS GENERATOR AND CONTROLS

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Refer to Item 2.01 – “Ratings” for EPA Tier rating requirements before bidding.
- D. Contractor shall coordinate natural gas line installation with Utility Company. Within 30 days after “Award of Contract,” Contractor shall contact Utility Company and Owner and shall request service needed. It is Contractor’s sole responsibility to assure that Utility Company and Owner are notified and are kept aware of requirements. Owner and Engineer shall be advised in writing of Utility Company Service Representative handling service order, telephone number, address, and order number within thirty (30) days of contract award and notice to proceed. Contractor shall notify Engineer and Owner of proposed service lines to be installed by the Utility Company and Contractor and shall include copy of service report from Utility Company. Delays in services installed due to failure to make timely application shall be at Contractor’s expense.
- E. A complete generating system and all related equipment, including cooling system, coolant pumps, expansion tanks, valves, piping lubricating systems, fuel system components, miscellaneous devices and all required appurtenances shall be furnished and installed by the generator Manufacturers Supplier and/or Local Representative. It is the Generator Suppliers responsibility that any and all electrical and mechanical parts of the complete generator system that Supplier sub-assigns for installation by another Contractor be accounted for, approved and coordinated by said Generator Supplier. Any additional electrical and/or mechanical equipment or devices required for the specific generating system for this project shall be accounted for in Supplier and Contractor’s bid where or not shown in plan and specifications details for this project.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

NATURAL GAS GENERATOR AND CONTROLS

Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. It is accepted that each manufacturer listed may have variation in certain specified parameters that are particular to each specific product, and this is to be accounted for in bid and in the data submitted for Engineer's review. Failure to do so may result in equipment removal and replacement at Contractor's expense. See Section 16012 – "Electrical Work", Item 1.04 – "Submittals" for submittal requirements.

- F. Listing of acceptable Equipment Manufacturers does not limit or remove the intent of these specification requirements.**
- G. Refer to Specification Section 15012 – "Mechanical Work," for mechanical work methods related to generator installation.

1.01 SCOPE

- A. This section specifies the furnishing and installation of a natural gas packaged electric generating plant.
- B. The packaged, Natural Gas Generator-electric generating plant shall be pre-wired, pre-piped, assembled, and aligned on a single skid type base. The packaged system of new, unused equipment of the manufacturer's latest design includes all necessary instruments, devices, switches, and other appurtenances for proper operation of the unit: Supplies steel safety guards around all external rotating parts, and provides a unit on which adjustments, repairs, and normal maintenance are possible without the use of special tools. The supplier will be responsible for the proper performance of the complete unit and support systems. Only manufacturers with a minimum of 5 years experience will be considered. The supplier of the complete package must have complete parts and service available on a 24-hour basis in the area of the job site. Parts stock must be maintained on engine/generator by the supplier of the package.
- C. The successful bidder of this equipment shall herein be referred to as vendor.
- D. Any failure to take exception to any part of this specification in the initial bid by the vendor shall imply complete compliance to the specification and will subject the vendor to complete liability for any omitted items.

1.02 WARRANTY

- A. Contractor shall provide full 3-year service warranty on the overall installation, and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software.

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This warranty shall begin on date of written “Final Acceptance” of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor’s warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer’s products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its affect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that manufacturer’s warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor’s expense and at no additional cost to the Owner.

- B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

1.03 STANDARDS AND CODES

- A. All material and equipment supplied under this specification shall be designed, assembled, and tested in full compliance with the latest edition of the following codes and standards:
 - 1. NEC - National Electric Code
 - 2. IEEE - Institute of Electrical and Electronic Engineers
 - 3. UL - Underwriters' Laboratories
 - 4. NEMA - National Electronic Manufacturers Association

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- 5. ASA - American Standards Association
- 6. ANSI - American National Standards Institute
- B. The generator shall be listed by UL2200 as a complete assembly.
- C. Generator system shall comply with all EPA, state and local requirements where generator size shown on plans is not properly rated. The next size up shall be supplied.

1.04 DRAWINGS AND DATA

- A. Provide CAD files of diagrams, equipment views, and material & device schedules on CD and include with submittals. Only one (1) copy required for Electrical Engineer. Only electronic files will be reviewed. Hard copy submittals are not acceptable and will be returned as rejected.
- B. Six (6) copies of the following items are required of the successful bidder prior to manufacture:
 - 1. Certified dimensional drawings showing weight, outline dimensions, weights, bolting and drilling details, clearances for installation, operation and maintenance, and required ventilation.
 - 2. Elevation views, showing and identifying all items furnished and section views as required to locate all components.
 - 3. Bill of material describing all components and recommended spare parts with pricing and delivery.
 - 4. Brochures on engine, generator, muffler, batteries, charger, control panel, and any accessory equipment showing ratings, construction features, and performance characteristics.
 - 5. Schematic and wiring diagrams of the electrical system showing all factory wiring and clearly indicating wiring and voltage of any electrical strip heaters. Also, submit fully detailed inter-connection drawings indicating each individual connection to any remote equipment, including a separate connection drawing to show point-to-point electrical wiring connections.
 - 6. Submit documentation showing compliance with EPA/TCEQ emission requirements via location and EPA “TIER” rating. Include the current EPA

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conformity documentation for engine supplied with submittal package for review.

7. Calculations of steps, voltage drops, and kVA.
8. Descriptive literature describing the standard series specified (not a one-of-a-kind fabrication).
9. Drawing submittal schedule with approval allowance requirements.
10. Shipping time after receipt of order.
11. Exceptions and clarifications to this specification.
12. Factory testing procedures.

1.05 SUBMITTALS

- A. Factory and Field Tests - Deliver to the purchaser six (6) copies of each factory and field test report on the actual packaged electric generating plant provided, indicating results for all tests described herein.
- B. Operation and Maintenance (O&M) Manuals - Two weeks prior to final inspection, deliver to the purchaser six sets of the manufacturer's operation and maintenance manuals pertaining directly to the unit provided. Bind each set in a substantial binder, with each item properly indexed. Include the following information:
 1. Project record drawings clearly indicating operating features and including as-built shop drawings, outline drawings, schematic and wiring diagrams.
 2. Instructions for erection and alignment, including tolerances and preparation for use.
- C. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- D. Submit all products covered under this specification for Engineer's approval. Refer to Section 16012 – "Electrical Work," Item 1.04 – "Submittals" for additional requirements.

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- E. With each submittal, include an electronic copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
- F. Provide CAD files of all diagrams, equipment views, and material and device schedules on CD and include with submittals. Only one (1) copy required for Electrical Engineer. Only electronic files will be reviewed. Hard copy submittals are not acceptable and will be returned as “Rejected.”

PART 2 PRODUCTS

2.01 RATINGS

- A. Natural Gas Driven Generating Set, complete with accessories, shall be at minimum the KW rating shown on plans and as manufactured by the following:
 - 1. Cummins/Onan (Southern Plains Power, Inc.)
 - 2. Detroit Diesel (Stewart & Stevenson)
 - 3. Kohler
 - 4. Caterpillar
 - 5. Taylor Power Systems
 - 6. Or, as approved in writing 1 week prior to bid date.
- B. Generator shall be at minimum the kVA shown on plans at a 0.8 power factor. If a particular Manufacturer’s unit of kVA shown on plans does not have proper EPA Tier ratings or, will not start all loads then, next largest size meeting these requirements shall be used. Voltage rating should be as shown on plans. Generator shall be capable of starting all plant loads sequentially, starting with smallest load first and progressing up to largest load, in steps. Refer to one-line diagram and load analysis on drawing sheets. Generator shall be capable of starting loads in sequential order, smallest to largest loads, with not more than 20 percent terminal voltage drop, and not more than 5 percent frequency drop. Voltage drop shall be defined as the voltage drop at a period of time specified by the Engineer after review of the generator data sheets.

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- C. Structural design is based on the listed generator manufactures units of kva, weights and dimensions indicated on plans. Any other bidders shall be responsible for confirming the designed structure is sufficient for other generators submitted for bidding, and shall provide confirmation before bidding. After job is awarded, all suppliers shall submit detailed plans for installation in compliance with Specification 16013 – Electrical Specifications for Engineers review and acceptance.
- D. Contractor shall verify code letter of motors furnished and shall adjust generator size accordingly where code letters vary from design values.
- E. Generator system shall meet current EPA Tier 1, 2 or 3 status requirements as applicable. Where size shown on plans is not proper tier rated, the next size unit shall be supplied.
- F. When next size generator is required, all conductor and conduit sizes shall be adjusted accordingly.
- G. All generators installed after January 1, 2009 shall conform to new 2009 EPA emissions standards.

2.02 ENGINE

- A. Type - Liquid cooled, full natural gas electronic ignition engine, either naturally aspirated or turbocharged. Compression ratio to be 10:1 minimum.
- B. Rating - Provide an engine with brake horsepower not less than required by the full load rating of the generator, including losses, and with all accessories attached.
- C. Speed - The engine speed will be suitable for direct connection to the generator without exceeding engine manufacturer's published curves. Speed must not exceed 1800 RPM.
- D. BMEP - The engine BMEP will not exceed 150 PSI, when producing rated load. Piston speed shall be 1725 feet per minute or less.
- E. Construction:
 - 1. Replaceable liners.
 - 2. Two (2) valves per cylinder.
 - 3. Full pressure lube system with crankshaft driven oil pump.

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4. Full flow replaceable oil filter.
 5. Dry type air intake cleaner with restriction indicators.
- F. Starting System
1. Heavy duty, battery driven electric starter motor.
 2. A fully charged 12-volt lead acid, impact resistant, storage battery or batteries mounted on the unit. Make battery capacity sufficient for four cranking cycles at firing speed of 10 seconds duration each, with 15 seconds rest periods. Provide all battery cables, connections, electrolyte, and a hydrometer. Battery rack to have rubber coating or epoxy paint.
- G. Cooling System - The generator set will be furnished with a unit mounted radiator having sufficient capacity for cooling the engine when delivering full rated horsepower at the design ambient. The fan is to be engine driven pusher type. An immersion heater shall be furnished in the jacket water system. Where unit mounted radiator does not have sufficient cooling capacity a remote cooling system shall be furnished by Generator Supplier and shall include all equipment devices and pumps, expansion tanks, piping, and appurtenances required for a complete operating system.
- H. Exhaust System - High degree, critical-rated 316 stainless steel exhaust system with maximum silencing capacity muffler mounted on unit. Include a suitable length of flexible stainless steel exhaust tubing for mounting between engine and muffler. When V type engines are used, a wye type flex will be furnished all exhaust system components to be 316 stainless steel. Provide (1) digital exhaust gas temperature meter on in-line engine or (2) on "V" engine. Digital readout to be included in engine/generator control panel.
- I. Fuel System
1. Fuel Strainer.
 2. Fuel Flex Hose.
 3. Solenoid Shut-off Valve.
 4. Primary Pressure Regulator.

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- 5. Gas Train: Provide complete assembly of gas train for vapor withdrawal as required for serving generator from 4-5 psi source. (Coordinate with Gas Company.)
 - J. Provide governor of the full electronic type, Woodward or an approved equal, to maintain frequency stability at any constant load, including no load, within plus or minus 1/4 percent, and to maintain frequency regulation between no load steady state and full load steady within 3 percent.
 - K. Battery Charger: A static, solid-state type battery charger unit, which automatically controls the charge rate. Include a charging rate ammeter, thermal overload circuit and transformer. The charge shall be suitable for operation at 120 volts single phase, 60 Hertz. The maximum charging time to bring the batteries up to full charge will be 12 hours. Mount charger on unit, using adequate vibration devices. Charger shall be of the dual rate type.
 - L. Engines used in proposed generator set to be certified to comply with current US EPA and CARB Mobile Off-Highway Emission Limits when tested per ISO 8178 D2. Engines used shall also comply with TCEQ air quality regulations at location and time of installation.
 - M. Generator Manufacturer shall designate piping entry into generator, and shall consult with Contractor on fuel pipe sizes and routing. It is Contractor's responsibility to secure Manufacturer's directions and recommendations for a proper fuel system operation.
- 2.03 ALTERNATOR
- A. Type - Furnish a direct coupled, synchronous, brush-less type generator with amortiser windings, revolving field, exciter, and built-in static rectifier and statically regulated excitation system.
 - B. Rating
 - 1. Voltage and Phase, as shown on plans.
 - 2. Frequency - 60 Hertz.
 - 3. KW and KVA minimum rating as shown on plans.
 - 4. Power Factor - 0.8.

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- C. Insulation System - Class H, 150°C rise over a 40°C ambient. Alternator output rating to be achieved with maximum 80°C rise over 40°C ambient.
- D. Instantaneous Voltage Dip - Less than 20 percent when full load is applied to the unit.
- E. Voltage Stability - Maintain within plus or minus 2 percent of rated voltage at any constant from no load to full load.
- F. Voltage Regulation - Maintain within plus or minus 1-1/2 percent deviation from rated voltage between no load steady state and full load steady state. Voltage regulation shall allow motor starting with solid state soft starters and reduce voltage autotransformer starters, and shall maintain continuous power to the starter during the transition from Start to Run phase of operation.
- G. Enclosure: Weatherproof, except where sound attenuating is indicated on plans, see Section 16622 – “Sound Attenuating Enclosures.”
- H. Coupling - From engine, drive rotor through a semi-flexible coupling to ensure permanent alignment.
- I. Strip Heaters - Provide thermostatically controlled, low surface temperature space heaters to prevent condensation.
- J. Generator shall have automatic controls to protect generator from overload. Controls shall be independent of main breaker, which shall not be depended on or, used for, generator protection. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator for both single phase and three phase fault conditions. The system shall control the alternator output to provide 300% of rated current under short circuit conditions, for both single phase and three phase faults. Systems, which regulate single phase and three phase faults at identical excitation levels, are not acceptable. There shall be no exceptions to this requirement, regardless of standards for manufacturers listed in Item 2.01 – “Ratings.”
- K. Provide 100% rated circuit breaker. Where alternator is rated for 3 phase, 4 wire service greater than 800 amps, provide GFI trip function per NEC.

2.04 CONTROL PANEL

- A. General - Provide a control panel mounted to unit, which includes, but is not limited to, the following instruments and protective devices.

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1. A C ammeter.
2. Phase selector switch.
3. Current transformers.
4. A C voltmeter.
5. Automatic solid-state voltage regulator.
6. Rheostat for adjusting voltage plus or minus 5 percent of rated voltage.
7. Engine Malfunction Warning Lights:
 - a. Low oil pressure.
 - b. High water temperature.
 - c. Engine overcrank.
 - d. Engine overspeed.
8. Frequency meter.
9. Non-resetable elapsed time meter with a 9,999.9-hour maximum indication.
10. Coolant temperature gage.
11. Oil pressure gage.
12. Main circuit breaker - molded case type.
13. Combination alarm-shutdown system with manual reset and indicating lights for high engine temperature, low oil pressure, engine overspeed, and engine fail-to-start. Include an additional set of contacts for remote alarms.
14. Manual start/stop switch for control of engine.
15. Alarm dry contact closures as follows:
 - a. Low oil pressure
 - b. High water temperature

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- c. Engine overcrank
 - d. Engine run
 - e. Low fuel pressure
 - 16. Remote control contacts as follows:
 - a. Engine start via transfer switch (which will include power transfer).
 - b. Engine start via remote (which will not include power transfer).
 - 17. Control panel space heater.
 - 18. Provide space heater in generator set mounted control panel to prevent condensation.
- B. Provide remote annunciator with minimum of (6) six programmable relays for use as alarm outputs unit to be recess mounted in door of automatic transfer switch, except where ATS is outdoors, in which case annunciator shall be installed in the inner panel of the ATS or, on wall in MCC Room as shown on plans or otherwise designated by Engineer.
- C. All interface wiring connections shall be made in the control panel.
- D. Contractor shall provide fail and problem alarms and run signals to SCADA and fail and problem alarm signal to autodialer, when present. Provide circuits, devices, expansion modules, and programming as required.
- E. Non-resetable elapsed time meter with a 9,999.9-hour maximum indication.
- F. Provide data port for use with SCADA monitoring of generator status using ModBus protocol via Ethernet. Provide CD with program, information, and status display. Provide generator communication interface module with Ethernet connector, power supply, programming for SCADA system use and all appurtenances. Provide Owners copy of Manufacturer's software for use in displaying generator data. Include Manufacturers time for assisting in installation and set-up of program. Assist Systems integration Engineer in setting up plant controller PLC and/or SCADA.
- G. Provide factory built, U.L. listed, remote annunciator that interfaces with generator control panel.

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2.05 ENGINE START/STOP CONTROLS

- A. The engine controls shall be provided with bypassing of the low oil pressure shutdown circuitry during start-up.
- B. If unit fails to start in an appropriate time (normally 15 seconds), the starting circuit shall shut down for an appropriate time (approximate 15 seconds) and then repeat the start cycle. If the unit still fails to start after three start attempts, the overcrank alarm shall activate and the starting circuit shall shut down.
- C. The engine start/stop control shall be static solid state.

2.06 BASE

- A. Mount the assembled packaged unit on a base of welded structural steel, box type construction. Prime all exposed metal parts with a rust inhibitor and finish in durable machinery enamel.
- B. Vibration isolators shall be of the steel spring type.

2.07 WEATHERPROOF HOUSING – (WHERE INDICATED ON PLANS)

- A. Construction: Provide an overall weather protective housing with removable side panels and a hinged, padlockable meter panel door to make the engine generating plant suitable for outdoor installation. In addition, sound levels at the nearest property line shall not exceed 58 db at project locations within the City of Houston city limits or ETJ. Where sound attenuating housing is shown on plans, provide according to those specifications.
- B. Painting: Prime all exposed metal parts with a suitable rust inhibitor applied to the clean, bare metal, followed by two coats of epoxy paint for exterior weather.
- C. All doors and access panels shall be lockable. Provide mechanical (non-magnetic) contact switches on all moveable panels and doors to detect entry into generator enclosure.
- D. Contractor to coordinate with manufacturer on housing size prior to constructing concrete pad.
- E. Provide low voltage transformer, panel, and appurtenance sized for all low voltage requirements at generator. Provide feeder circuit from Motor Control Center.

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- F. Where Sound Attenuating Housing is shown on plans, refer to Section 16622 – “Sound Attenuating Enclosures.” Enclosure Manufacturer shall be consulted for piping and conduit entries into housing. Also, coordinate with Generator Manufacturer.

2.08 GENERATOR CONCRETE FOUNDATION

- A. Provide concrete pad as shown on plans. Use 3000 psi concrete with #5 rebar 12" O.C. Coordinate pad construction with generator drawings and weight.

2.09 GENERATOR ACCESS

- A. Where generator controls or enclosure step-up height is greater than 18 inches above grade, Contractor shall provide concrete or galvanized steel steps for access to controls or to enclosure.

2.10 LOAD BANK

- A. Load Bank Controls:
 - 1. Where permanent load bank is required, provide all controls, contactors, and devices needed to exercise generator on load bank. Normal plant loads shall not be on generator during load bank operation of generator.
 - 2. Coordinate with Generator Vendor.
 - 3. Submit load bank controls data.

2.11 GENERATOR MONITORING SYSTEMS

- A. Provide interface to the generator solidstate controller and route data signal (ModBus TCP) to data switch as shown on plans.
- B. Provide all software, programming, and devices required for monitoring trouble status, run status, alternator loading, and all other available status signals. Route data cable to monitoring station PLC via Ethernet switch as shown on plans. Provide assistance in setting up system during construction.

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- C. Provide all addressing information needed to display all alarm, function, and status information at PLC and HMI. Send information on CD or via e-mail to Engineer.

2.12 GENERATOR INSTALLATION

- A. Contractor shall consult with Generator Manufacturer on all aspects of generator installation to assure all work is proper and professional.

2.13 FUEL LINE ROUTING

- A. Fuel lines from supply source that are routed in generator stub area shall be installed in a covered trench or buried pipe sleeve and stubbed up into generator enclosure.

2.14 STORAGE

- A. Where generator is stored on site prior to installation, provide any heating or other measures required to prevent moisture accumulation in high humidity areas. Consult Manufacturer for requirements.

2.15 GENERATOR ACCESSORIES AND MISCELLANEOUS EQUIPMENT

- A. Contractor shall provide power, control, and instrument circuits as well as all fuel source piping and devices, cooling equipment, pumps, and related appurtenances, and all accessory equipment that is standard factory component supplied by the generator manufacturer as part of this installation. Contractor shall coordinate all requirements with generator vendor and include all materials and design in bid cost.

PART 3 EXECUTION

3.01 TESTING

- A. Test generator in presence of Engineer by initiating automatic start-up, progressively starting all loads, minimum load first and proceeding to last and largest load, voltage dip shall be demonstrated to not exceed 20% at each step.

3.02 INSTALLATION

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- A. Installation of generator shall be according to Manufacturer's instructions and shall be witnessed and inspected by Manufacturer's Representative. **Manufacturer services to be included in bid cost.**
- B. Do not install vibration isolation rubber pads at random locations under skids. Place continuous pad, that is width of skids or, do not place at all. Manufacturer is to advise on this requirement. Submit detail for Engineer's review.
- C. Install on concrete pad that is sloped to avoid any standing water under generator or skids. Standing water test will be conducted and where water stands, the concrete slab shall be reworked to provide satisfactory installation.
- D. All conduits shall be routed under generator pad and stubbed up at proper location. Coordinate stub-up location with Generator Manufacturer. Conduit shall not be visible on the outer generator pad itself.
- E. Fuel source piping shall be stubbed up in PVC sleeve and routed under generator pad to proper location. Confirm exact location of stub-up in generator with Manufacturer.

3.03 TESTING AFTER INSTALLATION

- A. Perform Startup test to insure all systems work properly together to include transfer switches, annunciator panel and other associated accessories.
- B. Perform a load bank test as follows:
 - 1. Utilizing a resistive load bank, load test the generator set as follows:
 - a. Load should be applied as 50% of the generator name plate output for the first 30 minutes, 75% of the generator name plate output for the next 30 minutes, 100% of the generator name plate output for the next 60 minutes, for a total run time of at least 2 hours.
 - b. At a minimum, record the following at least every 15 minutes during the test.
 - Time
 - Frequency (Hz)
 - Battery Voltage (DC)
 - Voltage (AC-L1, L2, L3)

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- Oil Pressure (PSI)
- Amperage (AC-L1, L2, L3)
- Coolant Temperature
- Power Factor (1.0)
- Ambient Temperature
- kW
- Exhaust Temperature
- Load Percentage

C. Perform a plant load test as follows:

1. After the resistive load bank test has been completed, perform a plant load test to confirm generator can run connected loads as designed. Testing shall be performed as a complete simulation of power loss- ie shut off main disconnect and observe generator starts and ATS transfers to back-up source as required. All loads shown for connection shall be operated for up to 15 minutes (full load) unless system parameters do not allow pumps to run for that amount of time. Coordinate system parameters with plant Operator who shall be present for all plant load testing.

Allow plant to run on generator under normal conditions for minimum of 1 hour. Record all values as shown for load bank testing every 5 minutes during plant load test.

2. Allow generator to run unloaded for at least 5 minutes before shutting down.

3.04 LOAD LIMITING

- A. Where generator is not sized to carry all motor loads simultaneously, Contractor shall provide inhibit relays and bypass switches to prevent operation of selected loads when on standby power. Locate devices in motor control section of MCC. **Refer to plans and specifications for requirements.**

3.05 FIELD TESTS

- A. Units shall be factory tested under design conditions. Purchaser, at his option, may witness test. Vendor shall give one (1) week notice before test is made.

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- B. Perform field tests at the site after installation is complete and in the presence of the Owner's Representative and Engineer.
- C. Manufacturer's Representative shall conduct field tests after electrical installation is completed and shall provide a certified report of these tests for the Owner and Engineer. The tests shall include sequential starting of all motor loads and recording the voltage dip as each motor starts. This report shall be sent to Engineer no less than ten (10) working days prior to "Final Acceptance" testing.
- D. Load testing shall be performed using a reactive load bank sized to simulate all loads running with largest load then applied. Provide written report of tests for Engineer's review.
- E. **Generator manufacturer shall provide adequate bid allowance to cover total cost of generator setup, startup, and testing by factory technician or local service representative and at no additional cost to owner or contractor.**

3.06 OIL DRAIN

- A. Provide oil pan valve with oil resistant drain hose extending to the skid and attached with stainless steel clamp to prevent oil spills when draining oil pan.

3.07 FIRE EXTINGUISHER

- A. Provide two (2) high quality portable fire extinguishers noted for natural gas flame suppression. Provide mounting brackets and install on both sides of the enclosure doors located in the electrical control panel area. Coordinate location with Owner.

3.08 EAR PROTECTION

- A. Provide dispenser with disposable ear protection devices on inside of generator enclosure near entry at controls section, or other location designated by Operator.

3.09 GAS DETECTOR

- A. Contractor shall provide natural gas leak detector with optimum LEC rating for an enclosed natural gas generator environment. Unit shall send alarm signal to autodialer (ATD) at lower limits, and shall inhibit starting of generator at limits that may ignite free gasses when generator starts or when electrical controls are activated. Provide

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alarm circuits to ATD, generator controls and to plant PLC or SCADA. Route data cable to plant PLC or SCADA. Provide RS-485 to Ethernet Adapter with power supply installed in PLC or SCADA controls section.

- B. Testing of installation shall be conducted by Generator and Detector Manufacturers to demonstrate proper operation of unit and confirm that gas leak alarm inhibits generator operation for a pre-set time delay until alarm condition is no longer present. Provide over-ride switch at generator control panel for use in event gas detector fails or gives false reading.
- C. Detector shall be manufactured by Detcon.

END OF SECTION

SECTION 16670
LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Specification 16012 “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Lightning system installation shall be performed by a UL listed lightning protection system installer. Provide certification documents.
- D. Install lightning protection system on canopy at elevated structure, as shown plans.

1.01 SECTION INCLUDES

- A. Specification for lightning protection system, including design, installation and materials.

1.02 REFERENCES

- A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - 1. NFPA No: 780 - Lightning Protection Code
 - 2. NFPA No: 70 - National Electrical Code
 - a. Section 250-106 - Spacing from Lightning Rods
 - b. Section 250-60 - Use of Lightning Rods
- B. American National Standards Institute/Underwriters Laboratories (ANSI/UL)
 - 1. UL 96 - Lightning Protection Components
 - 2. UL 96A - Safety Installation Requirements for Lightning Protection System

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LIGHTNING PROTECTION SYSTEM

- 3. Lightning Protection Institute (LPI)
 - a. LPI 175 - Installation Standards

1.03 SUBMITTALS

- A. Submit all products covered under this Specification for Engineer's approval.
 - 1. Outline dimensions and weights
 - 2. Installation and maintenance manual
 - 3. Catalog data
 - 4. Complete design and construction drawings
 - 5. Underwriters Laboratories, Inc. Master Label Certification
 - 6. Lightning Protection Institute certified system certification
- B. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark "Complies" or "Non-Compliance" or "Exception" adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.

1.04 QUALITY ASSURANCE

- A. See Part 3.02 - INSTALLATION

1.05 PREPARATION FOR SHIPPING

- A. Pack and crate materials to permit ease of handling and provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Advanced Lightning Technology
- B. East Coast Lightning Equipment
- C. Harger Lightning Protection

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LIGHTNING PROTECTION SYSTEM

- D. Thompson Lightning Protection
- E. Or, as approved in writing by Engineer.

2.02 DESIGN, CONSTRUCTION AND MATERIALS

- A. System Design: Provide a functional and unobtrusive lightning protection system. Departures from the Drawings or submittals shall be submitted to the Engineer for approval.
- B. Lightning Protection Equipment: Materials shall be copper and bronze and of the size, weight, and construction to suit the application and used in accordance with PLI, UL, and NFPA code requirements. Use bolt type connectors and splicers Class I and Class II structures. Pressure squeeze clamps are not acceptable. Use stainless steel mounting hardware to prevent corrosion.
- C. Aluminum Components: Aluminum materials may not be used except on roofs that utilize aluminum roofing components. On aluminum roofs or where aluminum parapet caps are used, the utilize aluminum components for roof lightning protection equipment to ensure compatibility. However, use copper down leads and grounding with the bimetal transition occurring at the through roof assembly with an approved bimetal through roof assembly.
- D. Use equipment which is UL listed and properly UL labeled. Equipment shall be new, and of a design and construction to suit the application in accordance with accepted industry standards and LPI, UL, NFPA, and NEC code requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. The Contractor is responsible for the following coordination with the building contractors:
 - 1. The lightning protection installer shall install a correct, neat and unobtrusive installation in cooperation with other trades. Provide planning that shows conductor routing and materials.
 - 2. The contractor shall seal and flash protection roof lightning penetrations conforming to the enclosure manufacturer's recommendations. However, the lightning protection contractor shall designate locations of the enclosure roof and submit details of through roof penetrations, as required.

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LIGHTNING PROTECTION SYSTEM

3. Should the canopy manufacturer require any special walk pads, membrane patches or pavers under the components of the lightning protection system, the lightning protection installer shall install such items with the roofing materials (patches, pads, pavers, adhesive) supplied by the contractor at no additional cost to the owner.
4. The contractor shall instruct the lightning protection installer of the proper installation procedures of the roof pads, patches and pavers, if required.

3.02 INSTALLATION

- A. Lightning system shall be installed by an experienced installation company that is UL listed, a member of the Lightning Protection Institute and an employer of Certified Master Installers of lightning protection systems.
- B. A certified Master Installer shall directly supervise the work. Install equipment in a neat, workmanlike manner. Provide and install a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper down leads, and proper ground terminals.
- C. Use copper down lead conductors even when aluminum is required on the roof. Do not bring down lead conductors in conduit directly through the roof. Use through roof assemblies with solid brass or stainless-steel rods for this purpose. Structural steel may be utilized in the installation as outlined by UL, NFPA, and LPI.
- D. Upon completion of the installation, the lightning protection installer shall secure and deliver to the Contractor for submittal to the Engineer, the Underwriters Laboratories, Inc., Master Label certification and the Lightning Protection Institute Certified System certification. The system will not be accepted without the UL Master Label plate and the LPI certification certificate.
- E. Provide minimum exposure of conductors. Do not route conduit exposed on outer edge of structure. Submit drawings for approval by Engineer.

END OF SECTION

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SECTION 16904
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PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. **Contractor shall comply with Programming Allowance requirements of Item 1.01 – “Work Included” of this specification section. Read before bidding. Allowance will be reimbursed by Owner by submitting invoicing from Engineers Integrator/Programmer.** Contractor or his Subcontractors are not responsible for contents of program installation and/or operation of program. Warranty for operation program is solely the responsibility of the Engineers Integrator/Programmer. There are to be no contractual agreements between the Contractor and/or his Subcontractors and the Engineers Integrator/Programmer. See Section 1.01 of this specification for full requirements.
- C. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- D. **Only Manufacturers listed in Item 1.04 – “Controller Assembly” may assemble controller panels for this project. Control Panel Manufacturers may not bid as “General Contractor” for SCADA System installations, unless approved by Facility Owner.**
- E. The Owner and the Engineer will review system technical information as submitted by the Contractor for hardware, peripheral devices, software operating system, database, control logic, and alarming for complete compliance with these specifications.
- F. Follow requirements of Section 16016 – “Control Panels” for controller panel assembly.
- G. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work,” Item 1.04 – “Submittals” for submittal requirements.

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1.01 WORK INCLUDED

- A. This section covers work necessary for the installation, field testing and startup and final documentation for a plant controller unit system hereafter referred to as the controller and as described herein.
- B. Programmable Logic Controller (PLC), Personal Computer (PC), laptop computer, Operator Interface Unit (OIU), and Human Machine Interface (HMI) hardware and software are to be provided by Contractor. All drivers and related software purchased by Contractor shall be compatible versions to allow satisfactory interface of systems.
- C. All software shall be provided by Contractor and shall include license, keys, access codes, and required drivers. All programming for the controller will be performed by Engineers Integrator/Programmer. Contractor shall provide an “Allowance” in his bid price for programming work. Software and equipment data shall be provided to Systems Integration Engineer at time of shop drawing submittal. Contractor shall allow for a minimum of 60 working days for loading and testing controller programs. Provide four (4) weeks advance notice to Programmer for downloading programs. See Section 16012 – “Electrical Work,” Item 1.00 – “Conditions” and Item 3.08 – “Testing and Setup” for additional information and conditions.

A temporary program will be downloaded for testing and may be removed at completion of testing. The final program will be down loaded at completion of SCADA system installation.

- D. Where radio, fiber optic, telephone, data line, communication line or other means of communications between control or SCADA system components is provided, Contractor shall be responsible for coordination of hardware and software to assure compatibility for satisfactory communications and accurate transfer of data is accomplished. Communications link shall be fully tested and properly working before Engineer’s testing, inspection or PLC programming will be conducted.

1.02 CONTRACTOR’S RESPONSIBILITY

- A. The Contractor shall be responsible for and shall provide for the supply, delivery, installation, certification, calibration, adjustment, testing and startup, of a complete, coordinated system, which shall perform the specified functions indicated herein, and as indicated on the plans.
- B. System Fabricators shall provide full warranty on all systems furnished for this project. Proof of warranty liability shall be provided before submittals will be accepted. It is the

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Contractor's responsibility to obtain the above noted certifications before accepting Fabricators or Suppliers products for this project. All equipment shall be of professional quality as a finished product. All components shall be manufactured for the explicit purpose of use. This includes both interior components and exterior finish of enclosures.

- C. Electrical Contractor shall have Master Electrician License for City or county in which project is located and shall have a State issued Master Electrician License.
- D. The Contractor shall provide experienced personnel to supervise, perform, and coordinate the installation, adjustment, testing, and startup of the control system. The personnel shall be present on-site as required to affect a complete and operating system.
- E. Furnish resume of experience for supervisor directly in charge of project and who will be directly supervising day-to-day on-site activities of contractor's employees or sub-contractors.
- F. Local construction permits shall be sole responsibility of Contractor. Local inspection authorities' acceptance is required before final acceptance of system.
- G. Any equipment, devices, or software required for this project, and that may be overlooked by Owner or Engineer at final acceptance, shall still be provided by Contractor at no cost to Owner regardless of period of time that expires before Owner requests to be furnished and installed.
- H. All equipment, instruments and devices provided for this project shall have means of protection from power line conditions such as surge, phase fail, or other line conditions that may damage equipment, instruments or devices furnished. It is vendors and manufacturers' responsibility to provide protective devices as required for maintaining warranty of furnished items and to assure no damage occurs from power line conditions.

1.03 CONTRACTOR QUALIFICATIONS

- A. Contractor (or Sub-Contractor) may be required to submit a statement of qualifications to the Engineer before bid is awarded for control system work. Qualification Statement shall show proof of similar plant installations for not less than four (4) recent projects in County of project location or, immediate vicinity thereof. Provide name of project; name of Owner, address and telephone number of Owner's representative who can be contacted for references regarding successful completion and satisfactory performance of most recent projects.
- B. See Section 16012 – "Electrical Work" for additional Contractor qualifications.

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- C. Electrical installers and programmers assigned to this project shall be full time qualified employees. Contract type employees are not allowed unless preapproved by Engineer. Contractor will be required to furnish proof of experience and employment where requested by Owner or Engineer or their Representatives.

1.04 CONTROLLER ASSEMBLY

- A. Controller assembly may be performed by the following System Integrators:
 - 1. Weimar Manufacturing
 - 2. Texas Industrial Control Manufacturing (TICM)
 - 3. BL Technology
 - 4. Ace Controls
 - 5. Systems, Inc.
 - 6. Or, as pre-approved by Engineer in writing five (5) days before bid date.
- B. Exact component requirements shall be confirmed with Controller Manufacturer's Local Representative.

1.05 SUBMITTALS

- A. Submit all products covered under this section for Engineer's approval. Provide entire submittal on CD. No exceptions.
- B. Hardware Submittals: Before any components are fabricated, and/or integrated into assemblies or shipped to the job site, furnish to the Engineer for his review six (6) copies of submittal documents. In addition, provide all submitted data on CD. Submittals shall include full details, shop drawings, catalog cuts and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these specifications. Specifically, the Contractor shall submit the following materials:
 - 1. Block diagram and operational description of the system showing all major components and their interconnections and interrelationships. Label each diagram and specify all external power and communications interfaces. All diagrams shall be in an 11 by 17 format. Provide CD in AutoCad Release 14 format.

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2. Drawings of equipment to be supplied shall include, as a minimum: overall dimension details for each panel, console, etc., including internal and external arrangements and door mounted operator devices with nameplate designations. Wiring diagrams of equipment including field device connections shall be included and specific installation/wiring requirements identified. Provide in AutoCAD format on CD.
3. Operational Description shall include the principal functions/capabilities of the controller, as provided and configured/programmed. Included shall be a description of system communications.
4. Provide a detailed Bill of Materials along with descriptive literature identifying component name, manufacturer, model number, and quantity supplied.
5. Provide system hydraulic layout(s) where applicable.
6. Complete wiring diagrams showing interface to other equipment. Contractor shall coordinate interconnection of equipment furnished by others.

C. Software Submittals

1. Provide user manuals for all PLC manufacturer furnished software and firmware. For ancillary software such as spreadsheets being supplied under this contract, only a listing of the manuals, which will be included with the O & M's, is required.
2. Provide communication and control database programs for project in hardcopy form. As a minimum, hardcopy form shall be fully documented, including code, comments, addressing data and cross-references, etc. Every line or section of code shall be accompanied by a comment describing its function.
3. Provide all required licensed programming software with submittals. All software to be new and original from PLC manufacturer. Provide on CD in original package. Provide any required "keys" or means for accessing and using software.
4. Test Outlines and Procedures Submittals: Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with this specification.
5. Spares and Expendables Recommendations: The Contractor shall provide a list of recommended spares and expendable items. The list shall be exclusive of any

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spares furnished under this Contract. A total purchase cost for the recommended list shall be provided in addition to the unit cost for each item. See Item 2.06 – “Spare Parts” for additional requirements.

6. With each submittal, include a copy of the applicable specification(s) page(s) for the item submitted and mark “Complies” or “Non-Compliance” or “Exception” adjacent to the applicable paragraph. Identify applicable drawing sheet number and specification section on front of each submittal cover.
7. All submittals for motor control centers, control panels, control sections, SCADA panels, pump panels, and Vendor furnished panels must contain statement of U.L. certification and identifying name and number of U.L. certification.
8. Provide Addresses for all vendor panel PLC controllers that have data interface with the SCADA PLC or PC controller. Provide Register Address of all functions and protocol used. Provide model number of PLC or controller. Request IP addresses from Engineers Programmer at time of submittal. All vendor PLC controllers to have data port and shall communicate via Ethernet protocol. Provide Ethernet adapter where required.

1.06 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The Contractor shall provide (6) complete sets of hard-covered ring-bound loose-leaf O&M manuals. In addition to “as-built” system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section. Provide in electronic format for Engineers and Owners records. See General Conditions of the Contract for additional requirements.

The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing and maintenance of each component and/or instrument. The O&M manual shall be professionally composed and compiled and shall not be an assembly of “cut-sheets.” Engineer shall have sole discretion of acceptance of O&M manual contents and composition. Refer to Specification Sections 16013 “Submittals” and 16014 “Electrical Work” for additional submittal and O&M Manual requirements.

- B. The contents of the O&M manuals shall be generally organized as follows:
 1. System Hardware/Installation
 2. System Software

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3. Operation (step-by-step procedures)
 4. Maintenance and Troubleshooting
 5. Schematic Diagrams and Wiring Diagrams
 6. As-Built Drawings
 7. Warranty Certificates
- C. Where a control system is to be installed under this contract or where existing and noted, the Contractor shall further provide a complete set of as-built plans, diagrams, parts and materials list, parts source, operational instructions, programming data, maintenance and trouble shooting instructions, service data, calibration data, testing data, required service and programming instruments and wiring diagrams sufficient for complete operation, service and programming and maintenance of the System by plant technicians and operators or by outside service technicians. This information shall be provided on CD in AutoCAD 14, or later version, and in Word format and shall be arranged in final order for insertion into System files. Coordinate overall layout and contents with Engineer and with System Programmer. Allow adequate person-hours for adjustment of layout and contents during System testing and Owner review. All data submitted will be reviewed by Engineer for acceptance and where deemed insufficient by Engineer, data will be resubmitted at no additional cost to Owner.

1.07 DEFINITION OF ACCEPTANCE

- A. System acceptance upon substantial completion shall be defined as that point in time when the following requirements have been fulfilled:
1. All O&M documentation has been submitted, reviewed, and approved.
 2. The complete control system and instrumentation have successfully passed all acceptance testing requirements specified herein and have successfully been started up, tested and accepted by the Engineer in writing. This includes the (90) day operating period described in Specification Section 16012 – “Electrical Work”, Item 3.08, Paragraph 2.
 3. All Owners’ staff personnel training programs have been completed.

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4. Owner/Engineer sign a document indicating system has formally been accepted. This will occur after all final inspection discrepancies have been corrected to Engineer's satisfaction.
5. Warranty certificates have been accepted.
6. All as-built drawings have been received and approved.
7. Spare parts have been delivered.
8. Where complete wiring diagrams have been delivered.

PART 2 PRODUCTS

2.00 GENERAL

- A. The functions and features specified hereunder are the minimum acceptable requirements for the system. The provided system shall equal or exceed each requirement.
- B. In some cases, the specifications may allow the accomplishing of certain functions by means of more than one hardware/firmware/software approach. Any approach that is proposed shall equal or exceed all functional, operational, convenience and maintenance aspects of the one described. Whether a proposed approach is equal to or exceeds specification requirements shall be in the sole discretion of the Engineer.
- C. Major equipment, component, and software items are specified; however, the Contractor shall, at no additional cost, provide all appurtenant items, whether specifically referenced herein or not, but which may be required for system operation as herein specified.
- D. All equipment, materials, and hardware shall be new and unused. Any failed equipment or device shall be replaced with new component. Repaired components are not acceptable.
- E. All solidstate controllers installed in MCC's shall have 2 hour UPS (under full load). All solidstate controllers installed in lift station control panels shall have 30 minute UPS.
- F. All signals up to point of PLC terminals shall be tested by Contractor and acknowledged in writing to Engineer prior to installation or testing programs.

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- G. Major components of this system shall include the specified materials, equipment, and installation required to implement a complete and operational control system along with associated instrumentation.
- H. In order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service to the greatest extent possible, like items of equipment provided hereunder shall be the end products of one (1) manufacturer.
- I. Requirements for the electrical work associated with the installation of the controller and instrumentation equipment are as specified in other sections.
- J. Controller shall be Siemens unless otherwise indicated on plans as higher-level unit, or equal, pre-approved in writing.

PLC Name	Series	Model	Location
PLC-1	S7-1500	CPU 1515-2 PN	Autosensory Panel

- K. PLC system to include all required processors, I/O modules, communication modules, and all other modules necessary for a complete operating system, mounted in factory rack or MCC section.
- L. All interconnect cables and connectors for PLC's, RTU's, and controllers shall be factory manufactured and/or assembled.
- M. All overcurrent protection devices for controls, PLC's, power supplies, etc. shall be circuit breakers, no fuses of any size are allowed.

2.01 FUNCTIONAL REQUIREMENTS

A. General

- 1. The controller system shall monitor and control the equipment functions stated herein, as described in other specifications, and as indicated on the plans. Functional requirements shall be coordinated with other equipment requirements and approved by the Engineer.

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2. Under this contract, the Control System Contractor is to interconnect all listed systems, setup controls for all systems and, in general, provide a complete unified operating control system.

2.02 COMPONENT SPECIFICATIONS

A. General

1. Where separate enclosures are indicated, enclosures shall be corrosion resistant welded NEMA Type 4X stainless steel for outdoor locations, NEMA Type 12 for indoor locations. Enclosure shall be fabricated from 316 stainless steel. Units shall include a single gasketed front door. Full height hinges, three (3) point latching handle with locking hasp and door restraints shall be included. Otherwise, provide enclosure as indicated in . All enclosures shall be UL listed.
2. Controls shall operate from a source of 120 Vac, 1 phase, 60 Hz UPS. All controls, radios, and telephone lines shall be protected from lightning or other transient voltages by power arresters and surge protectors on power lines, telephone lines, and radio coax cable.
3. Condensation protection shall be provided for panels not in climate-controlled environments. Enclosures shall have a heater, which operates continuously to prevent condensation build-up. A freeze protective heater and thermostat shall also be provided at those outdoor locations containing hydraulics. Where ambient temperatures (assume 110 degrees F) exceed component manufacturers specified maximum operating temperature by a factor of .85, cooling shall be supplied with the enclosure.
4. All DC power supplies required for operation of controller or instruments shall be provided. Units shall provide sufficient voltage regulation and ripple control to assure powered components can operate within their required tolerances. D.O. relay D.C. power supply shall have a separate UPS rated at 250 percent of the peak inrush of all D.O. relays activated simultaneously. Provide 120V, UPS circuit for power supply input.
5. Included shall be a battery backed UPS power source to run units for a period of twenty-four hours in the event of a failure of the normal AC source. Batteries shall be of the gel cell type and sized to provide power for the specified normal power fail period. The battery shall be kept fully charged using a regulated float

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voltage charging system. “Switching” type battery supplies are not acceptable. A fail output relay shall be provided and routed to alarm and PLC inputs.

6. Controller shall have an operational temperature range of 400 F to 1580 F, and a storage temperature range of -40°F to 176°F, under relative humidity conditions of 10% to 95% non-condensing.
7. All wiring shall be in complete conformance with the National Electrical Code, state, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required with non-adhesive clamps.
8. Outdoor controllers shall not have devices mounted in outer doors.

B. UL Labeling

1. Panels provided under this section shall meet the requirements of UL508. All panels shall bear the UL508 serialized label or be third party certified when delivered to the job site. All field modifications shall be in conformance with UL 508. When the Owner accepts the panels, the contractor certifies that the panels have retained their UL labeling or third party certification.

2.03 CONTROLLERS

A. General

1. Controllers shall be S7-1500 Series (or higher level where indicated on plans) as manufactured by Siemens, shall be provided for each indicated location in the system, and shall be installed as shown on the plan drawings or as otherwise directed by the Engineer.

Listing of a Manufacturer does not relieve obligation of meeting all conditions on this specification. All PLC's, RTU's, and controllers shall be warranted by the manufacturer for a period of not less than three years from date of final acceptance by Owner.

2. Configuration

- a. Processor Rack: Include processor, power module, memory card, CPU display, communication modules and input/output modules.

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- b. Expansion Rack: Include interface module, power module, micro memory card, communication modules, input/output modules and necessary connection cables.

B. Processor

- 1. The CPU shall have two RJ45 ethernet ports for programming and communications to all network devices. All devices shown on plans or described in specifications as connected to the LAN shall have ethernet connections to the network switch.
- 2. Integrated Program Memory: 500 KB
- 3. Integrated Data Memory: 3 MB
- 4. Address Area: 32 kbytes In / 32 kbytes Out
- 5. Execution Time, Bit Operations: 30 nanoseconds
- 6. Execution Time, Floating Point Operations: 192 nanoseconds
- 7. Ports: Two Ethernet RJ45, Integrated Switch
- 8. Display: Included with CPU
- 9. Storage Memory: Simatic Memory Card, at least 12 MB

C. Power Supply

- 1. The Programmable Controller shall operate in compliance with an electrical service of 85 to 265 VAC single phase, in the frequency range from 47 to 63 Hz, or DC power in ranges 108 to 132 VDC or 16.8 to 31.2 VDC
- 2. The manufacturer shall be able to provide as standard equipment a system power supply capable of converting above mentioned incoming voltages to the DC power required to operate the Programmable Controller system.
- 3. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Other power supplies shall provide power to remotely located racks.

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4. The power supply shall automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power.
5. The power supply shall monitor the incoming line voltage for proper levels. The system shall function properly within the above mentioned voltage ranges.
6. In addition, the power supply shall provide surge protection, isolation, and outage carry-over for a minimum of 5 ms for any power connection type.
7. Design features of the Controller power supply shall include a diagnostic indicator mounted in a position to be easily viewed by the user. This indicator shall provide the operator with the status of the DC power applied to the backplane. In addition, a means of disabling power to the CPU shall be possible from a power disconnect switch mounted in a position easily accessible by the operator.
8. At the time of power-up, the power supply shall inhibit operation of the processor and I/O modules until the DC voltages of the backplane are within specifications.
9. In addition to the electronic protection described above the power supply shall offer a failsafe fuse that is not accessible by the customer.

D. Input and Output Modules

1. General
 - a. All I/O shall be protected with miniature circuit breakers. Fuses are not allowed.
 - b. I/O modules shall be plugin mounted to the I/O mounting bases. I/O modules shall be designed to allow insertion at any point on the mounting base.
 - c. Each module shall have LED indicator to show I/O status, module health, and communication status.
2. Discrete inputs
 - a. Nominal Input Voltage of 120Vac or 24VDC as required
 - b. Provide 16 points per module

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3. Discrete Outputs
 - a. Output Voltage Rating of 10-265Vac or 5-125VDC
 - b. Output Current Rating
 - 1) 2.5A max per point
 - 2) 16A max per module
 - c. Provide 16 points per module
 - d. Isolated dry relay contacts will be furnished for all discrete outputs – Interposing relays will be furnished will be furnished to the I/O module.
4. Analog Inputs
 - a. Input Range of 4-20 mA
 - b. Resolution of approximately 16 bits across range
 - c. Provide individual isolators, in addition to the surge suppression devices specified, for all signals that enter the panel from outside the building. Substitution of Isolated Analog cards to meet this requirement is acceptable.
 - d. Provide 8 points per module
5. Analog Outputs
 - a. Output Current Range of 4 to 20 mA
 - b. Current Resolution of 12 bits across 20 mA
 - c. Calibration Accuracy - Better than 0.1% of range from 4mA to 20 mA
 - d. Provide 8 points per module

E. I/O Listing:

1. Refer to attachment A for the Controller's I/O arrangement. Contact Systems Integration Engineer for conformation of the controller's final I/O assignment

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for each device prior to fabrication of controller panel and before connections are made. Failure to coordinate will be at expense of Contractor and at no additional cost to Owner or Systems Integration Engineer

2. At least 25 percent I/O points of each type (AI, AO, DI, and DO) for future undefined use. All functions may not be on I/O list at end of this section. Provide all control functions shown on diagrams and plans.

2.04 CONTROLLER SOFTWARE

- A. Provide PLC Manufacturers licensed copy of Ladder Logic or PLC Manufacturer's other acceptable, licensed, programming software and all other required software specifically applicable to controller and modules provided and ship to System Integration Engineer according to project schedule. Software package shall include all original manuals available from PLC manufacturer or other pre-approved supplier.
- B. All software licenses required to achieve the functionality described in the Specifications shall be provided.
- C. The software package shall allow on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.
- D. All required hardware (including cables, cable adapters, etc.) for connection to PLCs shall be furnished.
- E. The software package shall include a software license agreement allowing the Owner the right to use the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project.
- F. The software shall be Microsoft Windows-based and run on the supplied computers
- G. The software shall include a security feature to prevent unauthorized personnel from modifying and downloading the programs.
- H. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

2.05 HUMAN MACHINE INTERFACE (HMI)

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- A. Unless specifically noted, the HMI to the system CCU, RTU, or controller shall be provided by means of a 15.0 inch industrial panel PC and shall be a product of Maple Systems, Model PC415C with Intel Core i3 G630T 2.3GHz CPU processing, 4GB DDR3, 250GB hard drive, and with operating and programming instructions and software. The terminal touch screen shall display controller analog and digital input/output signal status in appropriate engineering units. Terminal shall allow changes to set points, control parameters, and outputs. All changes by Operators shall be password protected. In addition to the controller displays, the terminal shall provide menu driven commands, communications status and statistics, alarm history and online help. Terminal shall communicate with the controller via an Ethernet interface or Ethernet crossover cable interface at the PLC LAN port.

A. Ports and Devices

1. The HMI and desktop PC shall have Ethernet 10/100 Mbps for communications with control system.
2. The HMI shall have one serial port RS-232 for communications with control system
3. The HMI shall have a minimum of two USB ports.

B. HMI and PC Software

1. Provide Maple Systems Web Studio Interface Software V8.0 Development (WEB-16520-NT) for Panel PC. 16,000 Tags and 5 Drivers.
2. Provide InduSoft Web Studio V8.0 Runtime Package (Maple Systems Part Number WEB-16520-RT). 16,000 Tags and 5 Drivers. Provide one runtime license for each HMI installed.
3. Provide Windows 7 Pro (embedded) with Panel PC and desktop PC.
4. Provide most current edition of Microsoft Office Professional.

2.06 COMPUTER SYSTEM HARDWARE AND SOFTWARE

A. General Requirements

1. Due to the constant technological evolution of the equipment specified, the requirements specified are to establish a baseline for the type of equipment

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required. Provide the latest hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified.

2. Equipment shall be ordered as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, submit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. No equipment shall be ordered more than three months prior to when it is needed to be continuously used on the project.

B. Computer Configuration and Accessories:

1. Power provided to the computer and its peripherals will be 120 VAC, single phase, 60 Hz. Computer shall be capable of operating satisfactory in an ambient temperature range of 60 to 90 degrees Fahrenheit with a relative humidity of 5% to 85% non-condensing.
2. All necessary communications and power cabling and/or cords between the PC, CCU, UPS, and all peripheral equipment shall be included. Provide surge suppression (energy ratings of up to 2655 joules with maximum spike amperage of 135,000 amps) eight (8) outlet power strip (include LED indication lights to verify that all devices are ground and protected) for connection of all devices as required.
3. Computer system shall include server grade hardware Dell PowerEdge T330 or equal with Intel Xeon Processors E5-2430L 2.00GHz, 15M Cache, 7.2GT/s QPI, Turbo, 6C, 60W, Max Mem 1333MHz
4. Memory Configuration Performance Optimized
5. Memory DIMM 1600MT/s UDIMMS
6. Memory Capacity 4GB UDIMM, 1600MT/s, Low Volt, Single Rank, x8 Data Width. Total quantity of six (6).
7. Operating System Windows Server 2012R2, Standard Ed, Factory installed, No MED, 2SKT, 2VM, NO CAL
8. OS Media Kits Windows Server 2012R2, STD Ed, Media Kit w/Factory Inst ENT DGRD images

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9. Chassis with up to 8, 3.5” Hot-Plug Hard drives
10. Raid 5 for H710P/H710/H310 (3-16 HDDs)
11. 1 TB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hot-plug Hard drive. Total quantity of four (4).
12. Dual, Hot-plug, redundant Power Supply (1+1), 495W
13. NEMA 5-15P to C13 Wall Plug, 125 Volt, 15amp, 125V10F 10 feet power cord
Total quantity of two (2).
14. Power Saving Dell Active Power Controller
15. Basic Embedded Systems Management
16. Add-in Network Adapter, On-Board Broadcom 5720 Dual Port 1 Gb LOM
17. Tower Chassis, no casters
18. Security Bezel
19. DVD +/- RW, SATA, Internal
20. Fan Fault Tolerance
21. Electronic System Documentation and Open Manage DVD Kit
22. Warranty: ProSupport Plus 3 year Next Business Day Onsite Service
23. Minimum of one (1) Ethernet port, and four (4) USB ports shall be provided.
24. Computer shall be FCC Class B certified for EMI/RFI and UL/CSA approved.
25. Accessories:
 - a. Provide two 4GB removal USB drives for storage
 - b. “Quietkey” keyboard,
 - c. two (2) button mouse with wheel (Microsoft compatible)

C. Video Display System

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1. Main video display system shall be able to display alphanumeric data and vector graphics. Both text and graphics shall be able to be displayed on the screen simultaneously.
2. A Super Video Graphics Array video adapter card shall be provided. Board shall include a minimum of 2 MB video memory and capable of displaying 1280 by 1024 resolution graphics in 32-bit true color.
3. Provide one 23-inch color LCD, thin screen monitor, Dell P2314H or pre-approved equal.

D. Uninterruptible Power Supply (UPS)

1. An uninterruptible power supply (UPS) shall be furnished to continuously provide a reliable source of power to the computer and peripherals and, a separate UPS shall be furnished to provide a reliable source of power to the CCU, radio, and related systems. Units shall provide no-break sine wave power, lightning and surge protection, and isolation per FIP Standard 94, voltage regulation and be switch-mode power supply rated. Standby power supplies, which allow a break in power when transferring to battery, are not acceptable.
2. The UPS units shall be sized to accommodate 150% of the maximum load of the PC, monitor, and all local peripherals, for a period of 4 hours. UPS units shall utilize sealed, maintenance free batteries to provide a minimum of 1 hour of backup power at full load in the event of a failure of the normal AC source.
3. Unit shall include LED indicators for AC line ready, charging, battery power, and alarm. An on-board Ethernet port shall be included to allow computer monitoring of UPS alarm and status points. Provide unit and associated software as manufactured by Best Power Technology or pre-approved equal.

E. PC Hard Drive Protection:

1. Provide Norton's Ghost software and an extra hard drive. They are to work together as a backup solution in the case of a system crash to:
2. Backup everything on the PC
3. Recover the system and data even when the operating system cannot be restarted.
4. Make incremental backups to maximize space and save time.

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5. Make backups on the fly, without restarting the system.

2.07 SPARE PARTS

- A. Spares and Expendables Recommendations: The Contractor shall provide the spare parts under this contract.
 1. CPU: Provide spare processor unit(s) for each model CPU installed.
 2. Power Supply: Provide spare power supply for each model installed.
 3. Memory Cards: Provide spares for each type of card installed.
 4. I/O Cards: Provide spares for each unique I/O module type installed. Provide two or 10 percent of installed quantity, whichever is greater.
 5. Network interface and communication modules: Provide one spare communication module for each unique communication module installed.
- B. All parts to be in original protective packages and stored on site after acceptance by Engineer.

PART 3 EXECUTION

3.00 GENERAL

- A. Coordinate all work with the Engineer/Owner to avoid conflicts, errors, delays and unnecessary interference with operation of the existing system during installation, testing, cut-over and startup.
- B. Install all new equipment in accordance with the manufacturer's instructions and approved submittals.
- C. Provide adequate person-hour allowance for coordination with Systems Integration Engineer, Programmer, Owner, other Sub-Contractors, and Controller Manufacturer.
- D. In addition to spare I/O's, provide additional 18 inches of DIN rail space for future use in control panels.
- E. See "Systems Acceptance" requirement in Specification Section 16012 – "Electrical Work," Item 3.03.

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3.01 PROGRAMMING PERIOD

- A. Contractor shall install controller and peripheral devices in a timely manner so as to allow the following time periods for program installations:
 - 1. Controller: Allow a minimum of 60 working days for downloading and testing. Provide 4 weeks advance notice.
 - 2. Failure to meet these schedules or project completion delays due to lack of Address data for vendor PLC controllers or incomplete PLC I/O terminations will be at expense of Contractor and at no additional cost to Owner.
- B. Failure to meet these schedules will be at expense of Contractor and at no additional cost to Owner. Project completion delays caused by Contractor's failure to meet these scheduled periods are at Contractor's risk and expense and at no additional cost to Owner.
- C. See Specification Section 16012 – "Electrical Work," Item 3.08 – "Testing and Startup," for additional information on shop testing requirements.
- D. Note that all field inspections will be made when Contractor notifies Programmer that system is fully operational and ready for testing. This inspection will be prior to any programming work. Where system is determined to not be properly operational, the Engineer will notify Contractor of corrective action required before programming activity will commence. Contractor is solely responsible for any contractor delays where system is not ready for programming.

3.02 TESTING AND STARTUP

- A. All elements of the control system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing of materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner and Systems Integration Engineer. As a minimum, the testing shall include both a factory test and a field test. Testing requirements are as follows:
 - 1. Factory Tests: The controller and all other associated hardware shall be tested via a full simulation at the factory, prior to shipment, so as to demonstrate that each component is operational and meets the requirements of these specifications. Provide a "Test Routine" type program for shop testing I/O wiring and interconnect wiring of components. Test results shall be certified, with written

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documentation provided to the Engineer upon test completion. Factory testing may be witnessed by the Engineer.

2. Field Tests: All system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. Contractor shall provide a checklist for all electrical, control and instrumentation functions and send to Engineer for approval. Each function shall be demonstrated to the satisfaction of the Owner and Engineer on a paragraph-by-paragraph basis. Each test shall be witnessed and signed off by the Contractor and the Engineer upon satisfactory completion. The Contractor shall notify the Owner at least two (2) weeks prior to the commencement date of the field tests. After tests are completed and with system fully operational, system shall run continuously for a period of 90 days without failure. Any failures shall be repaired and test shall start over again.
3. Prior to loading PLC or SCADA programming and prior to any PLC or SCADA set up by programmer, an inspection may be conducted by Engineer's Inspector to assure electrical controls are functioning properly. Any discrepancies or problems shall be corrected and then Contractor shall send a written notice that complete electrical control system is installed and operating per the Plans and Specifications. This notice shall be signed by an Officer of the General Contractor's company.
4. Prior to testing system of PLC programs or HMI programs provided by other than the Systems Integration Engineer noted in Item 1.01 – "Work Included" all programs shall be furnished on CD for review by Engineer. Provide any special software necessary to run and test complete program.

3.03 TRAINING

- A. The training program shall be conducted by the Controller Manufacturer's Representative or, pre-approved qualified Instructor or approved, qualified Instructor and shall educate operators, maintenance, engineering, and management personnel with the required levels of system familiarity to provide a common working knowledge concerning all significant aspects of the system being supplied. The training program shall consist of the equivalent of two (2) 8-hour days and conforming to Owner's schedule of operators. Only field site sessions shall be provided. At least 2 weeks prior to the requested start of the program, the proposed dates of training shall be submitted to the Owner and the Engineer for approval.

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- B. The Training Instructor shall provide all instructional course material, equipment, and manuals to conduct the training program. Owner shall provide facilities for the training.
- C. The training program shall be conducted as follows:
 - 1. Initial training shall familiarize the student with the fundamental operation of any microprocessors, operating systems, software programs, and programming languages installed in this project.
 - 2. Operator training shall be conducted utilizing the actual system.
 - 3. Maintenance training shall address each item of equipment being supplied down to the individual module, board, or card level.
 - 4. Programming or configuration training shall, as a minimum, address; graphic display creation and editing; ladder diagrams; special housekeeping requirements; configuration of all specified functions; and the addition of new equipment to the system.
 - 5. The training shall provide Owner personnel with basic proficiency in operator interface unit functions pertaining to the specified system.
 - 6. A minimum of 75 percent of training time shall be dedicated to actual operation and use of the control system as encountered in day-to-day operations.
 - 7. Engineer's representative may be present during training.
 - 8. The Controller Training Instructor shall provide a professional written and published training manual for Owner's use during training classes.

Provide four (4) copies for Engineer and Owner's approval four (4) weeks prior to training. Provide six (6) copies for training after approval. Manual shall be professionally bound.

PART 4 WARRANTY

4.00 GENERAL

- A. Contractor shall provide full 3-year service warranty on the overall installation, and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment,

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devices, hardware, and software. This warranty shall begin on date of written “Final Acceptance” of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor’s warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer’s products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its effect on the product. Contractor is fully responsible for assuring that product manufacturers are aware of this condition and that manufacturer’s warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor’s expense and at no additional cost to the Owner.

- B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

PART 5 PLC I/O LIST

5.00 PLC INPUT/OUTPUT LIST

- A. Use attached I/O List as follows for bidding purposes. Engineer will confirm at time of Submittals.

END OF SECTION

PLC Name	Model	Rack Slot	Type	Point	Tag Name	Description	Eng Units	Low Range	High	Point Chk
PLC-1	S7-1500	0 0	PSU	-	-	-	-	-	-	-
PLC-1	S7-1500	0 1	CPU	-	-	-	-	-	-	-
PLC-1	AI 8xU	0 2	AI	0	PS1	GST Pressure Transmitter PS1	PSI	0	100	
PLC-1	AI 8xU	0 2	AI	1	PS2	Well Pressure Transmitter PS2	PSI	0	100	
PLC-1	AI 8xU	0 2	AI	2	PS3	Extra Low Level Transmitter PS3	PSI	0	100	
PLC-1	AI 8xU	0 2	AI	3	W1_VIB_X	Well Vibration Sensor X-Axis	IN/S^2	0	2	
PLC-1	AI 8xU	0 2	AI	4	W1_VIB_Y	Well Vibration Sensor Y-Axis	IN/S^2	0	2	
PLC-1	AI 8xU	0 2	AI	5	Spare	-	-	-	-	
PLC-1	AI 8xU	0 2	AI	6	FLM_100	Flow Meter 100	GPM	0	2000	
PLC-1	AI 8xU	0 2	AI	7	FLM_200	Flow Meter 200	GPM	0	2000	
PLC-1	AI 8xU	0 3	AI	0	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	1	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	2	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	3	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	4	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	5	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	6	Misc Inputs	See control diagrams	-	-	-	
PLC-1	AI 8xU	0 3	AI	7	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	0	BP1_HAND	Booster Pump No. 1 Hand	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	1	BP1_AUTO	Booster Pump No. 1 Auto	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	2	BP1_OL	Booster Pump No. 1 Overload	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	3	BP1_RUN	Booster Pump No. 1 Run	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	4	BP1_CALLED	Booster Pump No. 1 Called (Backup)	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	5	BP1_SR	Booster Pump No. 1 Start Relay	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	6	BP1_BS	Booster Pump No. 1 Bypass Selector	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	7	BP1_IR	Booster Pump No. 1 Isolation Relay	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	8	BP1_IC	Booster Pump No. 1 Isolation Contactor	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	9	BP1_BC	Booster Pump No. 1 Bypass Contactor	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	10	BP1_SSRV_RUN	Booster Pump No. 1 SSRV Run	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	11	BP1_SSRV_ISO	Booster Pump No. 1 SSRV Isolation	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	12	BP1_SSRV_EOS	Booster Pump No. 1 End of Start Up	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	13	BP1_SSRV_SSF	Booster Pump No. 1 Soft Start Fault	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	14	BP1_PFR	Booster Pump No. 1 Phase Fail Relay	-	-	-	
PLC-1	DI 16x24VDC	0 4	DI	15	BP_CTR	Booster Pump Control Transfer Relay	-	-	-	

PLC Name	Model	Rack Slot	Type	Point	Tag Name	Description	Eng Units	Low Range	High	Point Chk
PLC-1	DI 16x24VDC	0 5	DI	1	BP2_HAND	Booster Pump No. 2 Hand	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	2	BP2_AUTO	Booster Pump No. 2 Auto	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	3	BP2_OL	Booster Pump No. 2 Overload	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	4	BP2_RUN	Booster Pump No. 2 Run	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	5	BP2_CALLED	Booster Pump No. 2 Called (Backup)	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	6	BP2_SR	Booster Pump No. 2 Start Relay	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	7	BP2_BS	Booster Pump No. 2 Bypass Selector	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	8	BP2_IR	Booster Pump No. 2 Isolation Relay	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	9	BP2_IC	Booster Pump No. 2 Isolation Contactor	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	10	BP2_BC	Booster Pump No. 2 Bypass Contactor	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	11	BP2_SSRV_RUN	Booster Pump No. 2 SSRV Run	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	12	BP2_SSRV_ISO	Booster Pump No. 2 SSRV Isolation	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	13	BP2_SSRV_EOS	Booster Pump No. 2 End of Start Up	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	14	BP2_SSRV_SSF	Booster Pump No. 2 Soft Start Fault	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	15	BP2_PFR	Booster Pump No. 2 Phase Fail Relay	-	-	-	
PLC-1	DI 16x24VDC	0 5	DI	16	Spare	-	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	0	BP3_HAND	Booster Pump No. 3 Hand	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	1	BP3_AUTO	Booster Pump No. 3 Auto	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	2	BP3_OL	Booster Pump No. 3 Overload	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	3	BP3_RUN	Booster Pump No. 3 Run	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	4	BP3_CALLED	Booster Pump No. 3 Called (Backup)	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	5	BP3_SR	Booster Pump No. 3 Start Relay	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	6	BP3_BS	Booster Pump No. 3 Bypass Selector	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	7	BP3_IR	Booster Pump No. 3 Isolation Relay	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	8	BP3_IC	Booster Pump No. 3 Isolation Contactor	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	9	BP3_BC	Booster Pump No. 3 Bypass Contactor	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	10	BP3_SSRV_RUN	Booster Pump No. 3 SSRV Run	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	11	BP3_SSRV_ISO	Booster Pump No. 3 SSRV Isolation	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	12	BP3_SSRV_EOS	Booster Pump No. 3 End of Start Up	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	13	BP3_SSRV_SSF	Booster Pump No. 3 Soft Start Fault	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	14	BP3_PFR	Booster Pump No. 3 Phase Fail Relay	-	-	-	
PLC-1	DI 16x24VDC	0 6	DI	15	Spare	-	-	-	-	

PLC Name	Model	Rack Slot	Type	Point	Tag Name	Description	Eng Units	Low Range	High	Point Chk
PLC-1	DI 16x24VDC	0	7	DI	1	BP4_HAND	Booster Pump No. 4 Hand	-	-	
PLC-1	DI 16x24VDC	0	7	DI	2	BP4_AUTO	Booster Pump No. 4 Auto	-	-	
PLC-1	DI 16x24VDC	0	7	DI	3	BP4_OL	Booster Pump No. 4 Overload	-	-	
PLC-1	DI 16x24VDC	0	7	DI	4	BP4_RUN	Booster Pump No. 4 Run	-	-	
PLC-1	DI 16x24VDC	0	7	DI	5	BP4_CALLED	Booster Pump No. 4 Called (Backup)	-	-	
PLC-1	DI 16x24VDC	0	7	DI	6	BP4_SR	Booster Pump No. 4 Start Relay	-	-	
PLC-1	DI 16x24VDC	0	7	DI	7	BP4_BS	Booster Pump No. 4 Bypass Selector	-	-	
PLC-1	DI 16x24VDC	0	7	DI	8	BP4_IR	Booster Pump No. 4 Isolation Relay	-	-	
PLC-1	DI 16x24VDC	0	7	DI	9	BP4_IC	Booster Pump No. 4 Isolation Contactor	-	-	
PLC-1	DI 16x24VDC	0	7	DI	10	BP4_BC	Booster Pump No. 4 Bypass Contactor	-	-	
PLC-1	DI 16x24VDC	0	7	DI	11	BP4_SSRV_RUN	Booster Pump No. 4 SSRV Run	-	-	
PLC-1	DI 16x24VDC	0	7	DI	12	BP4_SSRV_ISO	Booster Pump No. 4 SSRV Isolation	-	-	
PLC-1	DI 16x24VDC	0	7	DI	13	BP4_SSRV_EOS	Booster Pump No. 4 End of Start Up	-	-	
PLC-1	DI 16x24VDC	0	7	DI	14	BP4_SSRV_SSF	Booster Pump No. 4 Soft Start Fault	-	-	
PLC-1	DI 16x24VDC	0	7	DI	15	BP4_PFR	Booster Pump No. 4 Phase Fail Relay	-	-	
PLC-1	DI 16x24VDC	0	7	DI	16	Spare	Spare	-	-	
PLC-1	DI 16x24VDC	0	8	DI	0	W1_HAND	Well No.1 Hand	-	-	
PLC-1	DI 16x24VDC	0	8	DI	1	W1_AUTO	Well No.1 Auto	-	-	
PLC-1	DI 16x24VDC	0	8	DI	2	W1_OL	Well No.1 Overload	-	-	
PLC-1	DI 16x24VDC	0	8	DI	3	W1_RUN	Well No.1 Run	-	-	
PLC-1	DI 16x24VDC	0	8	DI	4	W1_HDP	Well No. 1 High Discharge Pressure	-	-	
PLC-1	DI 16x24VDC	0	8	DI	5	W1_CALL	Well No. 1 Call Relay	-	-	
PLC-1	DI 16x24VDC	0	8	DI	6	W1_FTP	Well No. 1 Fail to Prime	-	-	
PLC-1	DI 16x24VDC	0	8	DI	7	W1_BSR	Well No. 1 Bypass Selector Relay	-	-	
PLC-1	DI 16x24VDC	0	8	DI	8	W1_SR	Well No. 1 Start Relay	-	-	
PLC-1	DI 16x24VDC	0	8	DI	9	W1_IR	Well No. 1 Isolation Relay	-	-	
PLC-1	DI 16x24VDC	0	8	DI	10	W1_IC	Well No. 1 Isolation Concator	-	-	
PLC-1	DI 16x24VDC	0	8	DI	11	W1_BR	Well No. 1 Bypass Relay	-	-	
PLC-1	DI 16x24VDC	0	8	DI	12	W1_BC	Well No. 1 Bypass Contactor	-	-	
PLC-1	DI 16x24VDC	0	8	DI	13	W1_MULT_NORM	Well No. 1 Multiin (Normal)	-	-	
PLC-1	DI 16x24VDC	0	8	DI	14	W1_MULT_BYP	Well No. 1 Multiin (Bypass)	-	-	
PLC-1	DI 16x24VDC	0	8	DI	15	W1_PFR	Well No. 1 Phase Fail Relay	-	-	

PLC Name	Model	Rack Slot	Type	Point	Tag Name	Description	Eng Units	Low Range	High	Point Chk
PLC-1	DI 16x24VDC	0 9	DI	1	W1_SSRV_RUN	Well No. 1 SSRV Run	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	2	W1_SSRV_ISO	Well No. 1 SSRV Isolation	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	3	W1_SSRV_EOS	Well No. 1 SSRV End of Start Up	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	4	W1_SSRV_FAULT	Well No. 1 SSRV Fault	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	5	W1_TD1	Well No. 1 Time Delay 1	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	6	W1_TD2	Well No. 1 Time Delay 2	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	7	W1_TD3	Well No. 1 Time Delay 3	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	8	Spare	-	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	9	W1_PRIMARY	Well No. 1 Primary	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	10	W1_BACKUP	Well No. 1 Backup	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	11	W1_CTR	Well No. 1 Control Transfer Relay	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	12	W1_SURGE	Well No. 1 Surge Protector Alarm	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	13	W1_HEATER	Well Motor Heater Current Switch	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	14	W1_OILER	Oiler Solenoid Valve Current Switch	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	15	CHL_SOLENOID	Chlorinator Solenoid Valve Current Switch	-	-	-	
PLC-1	DI 16x24VDC	0 9	DI	16	OIL_HEATER	Oil Reservoir Heater Current Switch	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	0	HT1_SELECTED	Hydrotank No. 1 Selected	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	1	Spare	-	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	2	HT_OP	Hydrotank Operational Probe	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	3	HT_HLP	Hydrotank High Level Probe	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	4	HT_LLP	Hydrotank Low Level Probe	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	5	HT_ADDAIR	Hydrotank Add Air Valve	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	6	HT_AA_HAND	Hydrotank Add Air Valve Hand	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	7	HT_AA_AUTO	Hydrotank Add Air Valve Auto	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	8	GST1_SELECTED	Ground Storage Tank No. 1 Selected	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	9	GST2_SELECTED	Ground Storage Tank No. 2 Selected	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	10	GST1_RESET	GST No. 1 Reset Probe	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	11	GST1_XLL	GST No. 1 Extra Low Level	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	12	GST1_HL	GST No. 1 High Level Probe	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	13	GST2_RESET	GST No. 2 Reset Probe	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	14	GST2_XLL	GST No. 2 Extra Low Level	-	-	-	
PLC-1	DI 16x24VDC	0 10	DI	15	GST2_HL	GST No. 2 High Level Probe	-	-	-	

PLC Name	Model	Rack Slot	Type	Point	Tag Name	Description	Eng Units	Low Range	High	Point Chk
PLC-1	DI 16x24VDC	0 11	DI	1	GST_XLL_BP	GST Extra Low Level Bypass Relay	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	2	CHL_GAS_ALARM	Chlorine Gas Detector Alarm	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	3	GST_HLP	GST High Level Pressure Switch	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	4	GST_LLP	GST Low Level Pressure Switch	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	5	W1_START	Well No. 1 Start/Stop	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	6	XLLPS	Extra Low Level Pressure Switch	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	7	Spare	-	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	8	MSB_CB	Main Service Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	9	W1_CB	Well No. 1 Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	10	BP1_CB	Booster Pump No. 1 Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	11	BP2_CB	Booster Pump No. 2 Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	12	BP3_CB	Booster Pump No. 3 Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	13	BP4_CB	Booster Pump No. 4 Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	14	GEN_CB	Generator Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	15	EXTL_CB	Exterior Lighting Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 11	DI	16	ALM_RES	Alarm Reset	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	0	CBP_CB	Chlorine Booster Pump Breaker Status	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	1	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	2	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	3	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	4	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	5	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	6	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	7	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	8	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	9	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	10	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	11	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	12	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	13	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	14	Misc Inputs	See control diagrams	-	-	-	
PLC-1	DI 16x24VDC	0 12	DI	15	Misc Inputs	See control diagrams	-	-	-	

PLC Name	Model	Rack Slot	Type	Point	Tag Name	Description	Eng Units	Low Range	High	Point Chk
PLC-1	DQ 8X24VDC	0 1	DO	0	BP1_SS	Booster Pump No. 1 Start	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	1	BP2_SS	Booster Pump No. 2 Start	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	2	BP3_SS	Booster Pump No. 3 Start	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	3	BP4_SS	Booster Pump No. 4 Start	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	4	W1_SS	Well No. 1 Start	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	5	SSC_CF	SSC Controller Fail	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	6	ALARM_RESET	Alarm Reset	-	-	-	
PLC-1	DQ 8X24VDC	0 1	DO	7	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	0	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	1	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	2	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	3	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	4	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	5	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	6	Misc outputs	See control diagrams	-	-	-	
PLC-1	DQ 8X24VDC	0 14	DO	7	Misc outputs	See control diagrams	-	-	-	

SECTION 16911

POWER MONITOR

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work”, Item 1.04 – “Submittals” for submittal requirements.

1.01 SUMMARY

- A. The Contractor shall furnish and install the Power Monitor equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings.

1.02 REFERENCE STANDARDS AND PUBLICATIONS

- A. General: The latest edition of the following standards and publications shall comply with the work of this section:
 - 1. ANSI/IEEE C12.20
 - 2. National Fire Protection Association, NFPA 70 - National Electrical Code
 - 3. National Electrical Manufacturer’s Association
 - 4. ISO 9001, Quality Management Requirements

POWER MONITOR

1.03 MANUFACTURER QUALIFICATIONS

- A. Eaton/Cutler Hammer shall be the basis of design. All products submitted shall comply with, meet, or exceed the specifications of the Eaton model type specified herein. Equal products as pre-approved are acceptable. See section 2.00 of this specification.
- B. The Manufacturer of the assembly shall be the Manufacturer of the major components within the assembly.
- C. For the equipment specified herein, the Manufacturer shall be ISO 9001 or 9002 certified.
- D. The Manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.04 WARRANTY

- A. Contractor shall provide full 5-year service warranty on the overall installation and shall include all labor and materials required to repair or replace equipment and/or components that are defective or malfunctioning. Included under this warranty shall be all equipment, devices, hardware, and software. This warranty shall begin on date of written “Final Acceptance” of the electrical systems and to be executed as required at no additional cost to the Owner. Contractor’s warranty shall also guarantee 24-hour service response time and shall provide labor, work, or materials as necessary to maintain plant operation when replacement parts are on order. In no case shall plant electrical systems be out of service for more than 24 hours from time Owner calls for warranty service. This shall be provided at no additional cost to the Owner. All equipment and materials installed shall have full warranty from Manufacturer that guarantees equipment is rated for harsh industrial electrical/mechanical environment in which it is installed. Where Manufacturer’s products fail prematurely, Manufacturer shall be fully responsible for new replacement and shall not have the option of declaring that failures were caused by environmental conditions and its affect on the product. Contractor is fully responsible for assuring that Product Manufacturers are aware of this condition and that warranty statement is included in shop drawing submittals. Failure to do so will be at the Contractor’s expense and at no additional cost to the Owner.

POWER MONITOR

- B. All critical warranted repairs shall be made within 24 hours of receipt of required parts from Manufacturer with reasonable delivery time of overnight shipping. Any repairs not completed within 5 working days from date of notice are subject to Owner making other arrangements for repair and back charging Contractor. This requirement is a condition of this contract.
- C. Where equipment or instrument problems remain unresolved by Contractor beyond a reasonable time, a Factory Technician shall be provided on-site to take any corrective actions necessary to put equipment or instruments in operating order. Owner and Engineer reserve the right to determine a reasonable time for corrective action by Contractor.

1.05 SUBMITTALS

- A. The Power Monitor submittals shall include, but shall not be limited to, the following information:
 - 1. Data for each type indicating conductor sizes, conductor types, and connection configuration and lead lengths
 - 2. Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification
 - 3. Drawings, with dimensions, indicating mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies
 - 4. List and detail all protection systems such as fuses, disconnecting means and protective materials
 - 5. Include installation details demonstrating mechanical and electrical connections to equipment to be monitored.
- B. Refer to 16013 Electrical Submittals for additional requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

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POWER MONITOR

- A. Equipment shall be handled and stored in accordance with Manufacturer's instructions. One (1) copy of Manufacturer's instructions shall be included with the equipment at time of shipment.

1.07 OPERATION AND MAINTENANCE (O&M) MANUALS & RECORD DRAWINGS

- A. O&M manuals shall be provided in accordance to 16014 Electrical O&M Manuals.

PART 2 PRODUCTS

2.00 MANUFACTURERS

- A. Eaton Cutler-Hammer
- B. Schneider Electric
- C. Pre-approved equal

2.01 Power Monitor – Service Entrance

- A. Provide a microprocessor based Power Quality Meter equal or better:
 - 1. Power Xpert PXM4000 with Webserver and Modbus TCP
- B. Electrical Requirements:
 - 1. Unit Operating Voltage – Refer to drawings for operating voltage and unit
 - 2. Power Monitor Requirements
 - 3. The device shall be capable of monitoring the following with a minimum accuracy of 0.5% of reading:
 - 4. Voltage (L-L and L-N)
 - 5. Amperes (all phases)
 - 6. Watts, Vars, VA
 - 7. Power Factor

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POWER MONITOR

8. Frequency
 9. Var-Hours, VA-Hours
 10. Ampere-demand, Watt-demand, VAR-demand, VA-Demand
 11. The device shall be capable of monitoring the following advanced parameters with all readings having a minimum accuracy of +/- 0.2%:
 - i. Individual Harmonics to the 40th harmonic
 - ii. Total Harmonic Distortion (Voltage/Current)
 12. Capable of trend logging and analysis up to 100,000 events with timestamp
 13. The device shall be capable of recording the waveform with a minimum of 512 samples per cycle.
 14. The device shall have a current range of at minimum .1-200% of nominal.
 15. The device at a minimum shall have a display capable of 3 lines with 4 characters each, with indication of parameter being displayed.
- C. The meter shall be capable of providing the graphically display of the following Main Meter Menu Screens:
1. Meter Screen providing:
 - i. Volts: L-L and L-N, and average
 - ii. Frequency
 - iii. Current and average phase A, B, and C, N & G
 - iv. Power Screen providing:
 - v. Energy
 - vi. Demand
 - vii. Power Factor

POWER MONITOR

- viii. Quality Screen providing:
 - ix. Total Harmonic Distortion (THD) of volts and current
 - x. Percent Nines (9s) reliability
 - 2. Events screen providing:
 - i. Latest events
 - ii. Enabled Triggers
 - iii. Historical Events
 - iv. Calendar view of Events
 - v. Events Timeline screen
 - vi. Set-up screen providing:
 - vii. View set-up
 - viii. Edit set-up
 - ix. Login
 - x. Logout
- D. Power Monitor – Communications
 - 1. The PQM shall be provided with multiple communications ports and protocols, including the following capability:
 - 2. RS-485 remote display port
 - 3. RS-485 Modbus RTU
 - 4. RJ-45 10/100 baseT Local Ethernet Configuration Port for local WEB server connection
 - 5. HTML web pages

POWER MONITOR

6. File transfer protocol (ftp)
 7. Modbus TCP
 8. SMTP(Simple Mail Transfer Protocol) for email support
 9. SNMP(Simple Network Management Protocol) MIB support
 10. Ethernet TCP/IP
 11. NTP(Network Time Protocol) support
- E. The WEB server shall provide the user with remote WEB access to all the metered, trend and waveform information. The WEB server shall include real time monitored information in both numeric and graphical visual formats.
- F. Event Logging: The embedded WEB Server shall allow the user to view a list of triggered events along with event details. In addition, a separate system log shall store logging of activities including acknowledged triggers, and systems operations, such as resets. Storage shall be reserved for 100,000 events.
- G. No additional software shall be required to access data or modify settings.

PART 3 EXECUTION

3.00 INSTALLATION

- A. The Manufacturer shall submit a written statement indicating that a factory technician has inspected the installation. The installing contractor shall submit a checkout memorandum to the manufacturer. The memorandum shall indicate the date the equipment is placed into service and the actual method of installation. Submit three copies to the specifying engineer.
- B. The installation of devices within or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.
- C. The contractor shall follow the Device Manufacturer's recommended installation practice as found in the equipment installation instructions.

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- D. The installation shall adhere to all applicable codes.
- E. System setup, calibration, and testing shall be conducted by factory trained technician, or a factory approved, qualified, independent technician.

3.01 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.02 TRAINING

- A. Provide training for set-up, testing, programming and operation for Owners Operators. Engineer may attend training classes. Training to be performed by an experienced factory trained technician, or a factory approved, qualified, independent technician at Owners facilities.

END OF SECTION

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

SECTION 16936

PILOT AND MISCELLANEOUS CONTROL DEVICES

PART 1 GENERAL

1.00 CONDITIONS

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- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. All equipment and devices shall be NEMA rated. IEC rated equipment and devices are not acceptable.
- D. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work,” for submittal requirements.

1.01 SUMMARY

- A. Section Includes:
 - 1. Pilot and control devices for instrumentation and control (I&C) system.
 - 2. Products listed are applicable where indicated on plans or required in other specifications.

PART 2 PRODUCTS

2.01 PUSHBUTTON/SELECTOR SWITCH CONTROL UNITS AND PILOT LIGHTS

- A. Manufacturers:
 - 1. Square D Class 9001, Type K
 - 2. Cutler-Hammer 10250T
 - 3. Allen Bradley 800T

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CONDUIT, FITTINGS, AND BODIES

4. Or, pre-approved equal
- B. Construction:
 1. Heavy duty
 2. Watertight
 3. Oiltight
 4. Base mounting
 5. Flush panel mounting
 6. Size to mount in 30.5 mm diameter opening without adapter. Smaller units are not acceptable.
 7. Padlock attachments, where required, constructed of metal. Plastic material is not acceptable.
 8. Legend plates, as required, for type of operation or as specified elsewhere.
- C. Pushbuttons:
 1. Flush head unless specified elsewhere.
 2. Contact Blocks:
 - a. Double break silver contacts
 - b. AC Ratings: 7,200 VA make, 720 VA break
 - c. Single pole, double throw or double pole, single throw
 - d. Up to six (6) tandem blocks
 3. Maintained contact unless specified elsewhere.
 4. Non-illuminated.
 5. Legend plates, as required, for type of operation or as specified elsewhere.
- D. Selector Switches:
 1. Maintained position unless specified elsewhere

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CONDUIT, FITTINGS, AND BODIES

2. Contact Blocks:
 - a. Double break silver contacts
 - b. AC Rating: 7,200 VA make, 720 VA break
 - c. Single pole, double throw or double pole, single throw
 - d. Up to six (6) tandem blocks
3. Operators:
 - a. Number of positions as specified elsewhere
 - b. Standard knob type unless specified elsewhere
- E. Pilot Lights:
 1. LED, high visibility type
 2. Colored lenses as specified elsewhere
 3. Interchangeable lenses
 4. Push to test
 5. Legend plates as specified elsewhere
- F. Enclosures:
 1. Mounted in control or instrument panel as specified elsewhere
 2. Control Station:
 - a. Environment:
 - 1) NEMA 12 in general areas
 - 2) NEMA 4X 316 stainless steel in wet locations or outdoors.
 - b. Flush or surface mounted as specified elsewhere.
 - 1) Provide flush mounted pull box.

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CONDUIT, FITTINGS, AND BODIES

G. Nameplates:

1. MCC: Section 16482 – “Motor Control Centers (600 Volts or Less)”
2. Control Stations:
 - a. Engraved laminated plastic
 - b. Letters 3/16 in. high
 - c. White letters on black background
 - d. Identify per equipment controlled

2.02 MOTOR STARTER CONTROL RELAYS

A. Manufacturers:

1. Square D
2. Cutler Hammer
3. Or pre-approved equal

B. Construction:

1. Industrial type
2. 300 V rated
3. AC operation
4. Pressure wire connectors

C. Operating Data:

1. Pickup Time: 11 ms maximum
2. Dropout Time: 6 ms maximum

D. Coil:

1. Molded construction
2. 120 VAC, 60 Hz

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

3. Continuous rated
 4. Color coded to indicate status
 5. Pilot duty
 6. 60A make, 6A break, (120 V inductive)
- E. Contacts:
1. Double break
 2. Silver alloy
 3. Convertible
 4. Color coded to indicate status
 5. Pilot duty
 6. 60A make, 6A break, (120V inductive)
- F. Track mounting capability.
- G. Accessories:
1. Add-on pole attachment:
 - a. 4 NO and 4 NC contacts
 - b. Add-on to 0 to 4 pole relay
 2. Latch attachment.
 3. Pneumatic Timer Attachment:
 - a. Single pole, double throw, double break timed contact.
 - b. Adjustable 0.2 to 60 sec.
 - c. Repeat accuracy of ± 15 percent.
 - d. Convertible timing mode.
 4. Transient Timing Mode: Suppress coil transients to 300 V or less.

CYPRESS FOREST PUD – WATER PLANT N0. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

H. All relays to be 4PDT type.

2.03 CONTROL RELAYS

A. Manufacturers:

1. Potter and Brumfield
2. Struthers Dunn
3. Or pre-approved equal

B. Operating Data:

1. Pickup Time: 13 ms maximum.
2. Dropout Time: 10 ms maximum.
3. Operating Temperature: -45°C to 70°C.

C. AC Coil:

1. 120 or 240 Vac.
2. Continuous rated
3. 3.5 VA inrush
4. 1.2 VA sealed
5. 50 to 60 Hz
6. Minimum Dropout Voltage: 10% of coil rated voltage.

D. DC Coil:

1. 24 or 120 Vdc.
2. Continuous rated
3. Minimum Coil Resistance
 - a. 24 Vdc: 450 ohm
 - b. 120 Vdc: 9,000 ohm

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

E. Contacts:

1. Silver cadmium oxide for 1 amp or less resistive load
2. Gold flashed fine silver, gold diffused
3. 4 Form C
4. 120 VAC
5. 20 amp make, 1.5 amp break (inductive)

F. Rated at 10 million operations

G. Plug-in sockets

H. Enclosed and protected by polycarbonate cover

I. Provide relay retaining clips.

J. All relays to be 4PDT type.

2.04 TIME DELAY RELAY

- A. ATC # 319D-016, with 2 SPDT switches rated 5 amps at 120 Volt, contacts and coil, plug in base and socket, 5 ranges, .02 seconds to 30 minutes.
- B. AGASTAT #7022AC, Instantaneous open on energization, time delay close on de-energization. Time range 1.5 seconds to 15 seconds, 120 volt, 60 Hz
- C. ATC Model #319D-134, with 2 S.P.D.T. switches rated 5 Amps at 120 Volt, contacts and coil, plug in base and socket, 3 ranges, .1 to 100 seconds.
- D. Macromatic Industrial Controls, Model #TAA1U, with two (2) S.P.D.P. switches rated 3 amps at 250 volt contacts, 24-240VAC/DC coil, plug-in base, six (6) functions, sixteen (16) ranges, 0.5 seconds to 10 hours.
- E. Or approved equal

2.05 ELAPSED TIME METER

A. Manufacturers:

1. Cramer #635G/HRS.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

2. Digits: Five (5), non-resettable.
3. Power: 120 VAC, 60 Hz.

B. Manufacturers:

1. Cramer #635S surface mounted.
2. Digits: Five (5), non-resettable
3. Power: 120 VAC, 60 Hz

2.06 TIMERS

A. 24 Hour Clock Timer (Repeat Cycle):

1. Manufacturers:
 - a. Tork Time Controls
 - b. Intermatic
 - c. Or pre-approved equal
2. Mounting: Surface
3. Display: 24-hr LCD
4. Contacts: One (1) SPDT rated 20A
5. Set Points: 288 per 24 hr.
6. Skip Feature: 1 to 7-day adjustable
7. Minimum On-Off Time: 5 min.
8. Time cycle programmable by keypad
9. Power: 120 VAC, 60 Hz

B. Interval/Duration Timer:

1. Manufacturers: ATC or equal.
2. Mounting: Plug-in with dust tight cover

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

3. Type: Integrated circuit
4. Range: As indicated on drawings
5. Contacts: Two (2) DPDT contacts rated 10 amp
6. Power: 120 VAC, 60 Hz.

2.07 PRESSURE SWITCHES

- A. Prosense PSD25 Series Pressure Switch, Model No. PSD25-OP-145H or other model as required. (Where shown on Plans.)
- B. Electronic, adjustable dials, pressure switch. Prosense Series PSD25 with factory cable.
- C. Bourdon Tube Pressure Switches with SPDT or DPDT mercury switch, adjustable dead band/differential, shall be used for all pump control and alarm applications. Size for range required. (Where shown on plans.)
- D. Mercoid Series DA and DS Bourdon Tube Pressure Switches, NEMA 4 weatherproof enclosure, manual reset, SPDT, mercury switch rated 4 amps at 120 volts. (Where shown on plans.)
- E. Mercoid Series BB Differential Pressure Switches, Bourdon Tube, SPDT, mercury switch rated 4 amps at 120 VAC. (Where shown on plans.)
- F. Mercoid Series PQ Ultra Sensitive Large Diaphragm Pressure Switches, where application requires.
- G. Honeywell Model L404A Pressure Switch 10-150 psi operating range, 8-16 psi subtractive differential, 120V, breaks on pressure rise. (Where shown on Plans.)
- H. Mercoid Series DA Model No. DRW-33-153L-7, 5-150 psi range, NEMA 4 weatherproof enclosure, manual reset, SPDT, mercury switch rated 4 amps at 120V. (Use all well discharge applications.)
- I. Mercoid Model No. DA-31-153-3A, 1/8 – 20 PSIG, brass bourdon tube, SPDT, mercury switch rated 4A at 120 VAC. (Where shown on Plans.)
- J. No exceptions for Manufacturer, series, or type switches without written approval.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

2.08 EXTERIOR MOUNTED ALARM LIGHT

- A. Manufacturers:
 - 1. Edwards
 - 2. Appleton Electric Company
 - 3. Crouse Hinds
 - 4. Or pre-approved equal
- B. 120 VAC
- C. Suitable for use in wet location, gasketed.
- D. Cabinet mounted, provide mounting lugs. Body to include outlet box.
- E. Aluminum mounting hood.
- F. Red glass globe with guard.
- G. $\frac{3}{4}$ inch conduit hubs

2.09 EXTERIOR MOUNTED ALARM HORN

- A. Manufacturers:
 - 1. Edwards
 - 2. Or, pre-approved equal.
- B. 120 VAC
- C. Suitable for use in wet location, gasketed.
- D. Cabinet mounted, provide mounting lugs. Body to include outlet box.
- E. Aluminum mounting hood.
- F. $\frac{3}{4}$ inch conduit hubs

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

2.10 ROTATING BEACON

A. Manufacturers:

1. Edwards: 40 Watts, 75 FPM, 120 Volt, 50-LMP, 4CW lamp red acrylic dome lens, Edwards #52R-N5-40W with wall mounted bracket Edwards #WBR.

2.11 ALTERNATOR

A. Manufacturers:

1. Diversified Electronics:
 - a. Two (2) Pump Duplexor:
 - 1) 24 VAC/DC, ARA-24-ABA.
 - 2) 48 VDC, ARA-48-ABA
 - 3) 120 VAC/DC, ARA-120-ABA
 - 4) 208 VAC, ARA-208-ABA
 - 5) 240 VAC, ARA-240-ABA
 - b. Three (3) Pump Triplexor:
 - 1) 24 V, ARA-24-AFE
 - 2) 120 V, ARA-120-AFE
 - c. Four (4) Pump Quadraplexor:
 - 1) 24 V, ARA-24-AGE
 - 2) 120 V, ARA-120-AGE
 - d. Two (2)/Three (3) Pump Duplexor/Triplexor: 120 V, ARA-120-AME
 - e. Three (3)/Four (4) Pump Triplexor/Quadraplexor: 120 V, ARA-120-ANE
 - f. Five (5)-Pump Pentaplexor: 120 V, ARP-100
 - g. Six (6)-Pump Hexaplexor: 120 V, ARA-100

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

2. Time Mark Corporation: 120 V, B 471
 3. Macromatic Industrial Controls: Two (2) pump duplexor, 120 volt, ARP120A6, 240 volt, ARP240A6
 4. Or equal as pre-approved by Engineer
- B. Provide automatic alternation of energizing motor starters.
- C. Permit operation of units singly or together as called by pilot devices.
- D. N.O. auxiliary contacts from motor starters required to operate alternator.
- E. Alternator shall provide for operation of standby or lag unit through second pilot device in event of failure of lead unit or first pilot device or alternator coil.
- F. With pump selector switch for operation of two (2), three (3), four (4) and five (5) pump systems.

2.12 PHASE FAIL PROTECTION DEVICES

- A. Diversified Electronics Model #SLD-440-ALE, 480 Volt, 3 Phase.
- B. Diversified Electronics Model #SLD-220-ALE, 240 Volt, 3 Phase.
- C. Macromatic Industrial Controls, Model #PMDU, 208-480 Volt, 3 Phase
- D. Franklin Electric or Equal, Submonitor Model #5860005000, 190-600Volt, 3 Phase, with detachable display
- E. Franklin Electric or Equal, Submonitor Model #5860005100, 190-600 Volt, 3 Phase, with detachable display
- F. Franklin Electric or Equal, Submonitor Model #D3 Dwonload Tools, with software and USB cable

2.13 FLOW SWITCH

- A. Vane operated stainless steel switches with vane length sized to maximum diameter of pipe.
1. Flowtect Series V4 Vane Operated Flow Switch, Model No. V4-SS-U-D for vertical mounting.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

2. Flowtect Series V4 Vane Operated Flow Switch, Model No. V4-SS-2-U-D-V with upward flow option for horizontal mounting (vertical pipe with upflow.)
 3. Static O Ring, Model No. 1520B-F5A-C-W1-EF-X, vertical mounting only.
 4. Potter Model IFS-WP.
 5. Or pre-approved equal.
- B. Thermal mass sensing stainless steel flow sensor with controls.
1. Kaydem Instruments, CMP 112 and 115 Flow Switch

2.14 UNIVERSAL AC CURRENT SENSOR

- A. Manufacturer:
1. Entrelec, SSAC, Inc. – P.O. Box 1000, Baldwin, NY, 13027
 2. Or, approved equal.
- B. TSC, ECS, ECSH, and ECSL Series: Provides relay contact closure when current reaches pre-set level.
- C. Install per Manufacturer's instructions.
- D. Sensor to be rated at 125% of current rating.

2.15 CURRENT TRANSDUCER

- A. Manufacturers:
1. NK Technologies
 2. Ohio Semitronics, Inc.
 3. Or, approved equal
- B. AT Series: Current transformer with signal conditioner. Split or solidcore as applicable. 420 model with 4–20 MA output. Self powered. 0 – 200 amp range. U.L. listed.
- C. A.C. Current Transformer Model No. MCT5, 005E or 005E2 (as shown on plans) with Manufacturer's recommended CT rated per circuit maximum amps x 1.25.
- D. AT/ATR Series: 0 – 200 amp range or, as required by motor current rating.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

E. Transducer to be rated for 125% of voltage rating.

F. Size unit to detect peak inrush current of motor.

2.16 VOLTAGE TRANSDUCER

A. Manufacturer:

1. Ohio Semitronics, Inc.

2. Or, approved equal

B. A.C. Voltage Transducer Model VT, rated per circuit maximum voltage x 1.25. Select version that matches shown on plans.

C. Transducer to be rated for 125% of current rating.

2.17 FLOAT SWITCH

A. Wastewater / Non-Potable Use:

1. Manufacturers:

a. Anchor Scientific

b. Conery MFG, Inc.

c. Pre-approved equal.

2. Construction:

a. Direct acting.

b. Polypropylene body.

c. Form C type contact mercury switch.

d. 10 amps at 230 VAC maximum.

e. Integral cord weight-zinc plated cast iron

B. Potable Water Use:

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

1. Manufacturer:
 - a. U.S. Filter
 - b. Pre-approved equal
2. Construction:
 - a. Model 9GEF, mercury free

2.18 DC INPUT, FIELD CONFIGURABLE ISOLATOR

- A. Manufacturer:
 1. Action Instruments, Model ACTIONI/Q Q406
 2. Or, approved equal.
- B. Construction:
 1. Provides one or two fully isolated DC output signals in proportion to one or two DC inputs.
 2. Field Configurable: 4-20 ma, 0-1 ma, 0-10V or 0-20 ma.
 3. 120 V power source.

2.19 SUBMERSIBLE LEVEL PROBE AND LEVEL RELAY

- A. Level Probe:
 1. Manufacturer: ITT Flygt/MultiTrobe Model 1.0/10-10M.
 2. Description: Submersible level sensing probe suspended from top of the wet well via power cable.
 3. Construction: Probe casing 1 ¼-inch epoxy filled PVC, sensor-Avesta 254 SM0 high-grade stainless steel alloy, cable PVC/PVC multi-core conductors (ten per probe).
- B. Level Relay:
 1. Manufacturer: ITT Flygt/MultiTrobe Model MTRA.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

2. Description: Level control relay for operation of pumps from the level probe input in the back up mode.
3. Display: Front face high intensity LED indication, power on (green), alarm on (red), and pump on (yellow).
4. Sensor: Three (3) inputs, 12 VDW, 0.8 mA max per sensor.
5. Sensitivity: 1K, 4K, 20K, and 80K ohms adjustable via dip switches.
6. Relay Output: Two (2) sets of NO output w/ adjustable time delay. Power requirements options for 240 VAC, 110 VAC, 24 VAC or 10-30 VDC.

2.20 SUBMERSIBLE LEVEL TRANSDUCER

I. Non-Potable Water Application:

A. Manufacturer:

1. CA Briggs
2. Mercoid
3. Pre-approved equal

B. Model: Blue Ribbon Bird Cage Water Level Sensor – Model BC 001

C. Surge Protector Blue Ribbon Corp. Surge Protector Model BCP 3000

D. Power: 10 - 30 VDC

E. Output: 4-20 mA.

F. Accuracy: plus/minus 0.1 percent of calibrated span, minimum.

G. Range: 0.2 to 100 meters of H₂O, minimum.

H. Sensor: Flush mounted ceramic.

I. Heavy stainless steel body.

J. Cable: Heavy duty, submersible rated with strain relief device.

K. Cable Length: Wet well depth plus length to terminal box with 10 feet slack coiled in terminal box (not in wet wells).

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CONDUIT, FITTINGS, AND BODIES

- L. Kellum grip with protective bushing. Suspend on stainless steel cable clear of pump and 4 inches above intake. Clamp transducer cable to stainless steel cable with suitable stainless steel clamps at 24-inch intervals. Provide epoxy coated lead weight at end of stainless steel cable. Provide stainless steel cable strain relief device at transducer that fits threaded connection at transducer, and that has ring for support by stainless steel cable.
- II. Potable Water Application:
 - A. Manufacturer:
 - 1. Dynotek
 - 2. Pre-approved equal
 - B. Model: Slim Line
 - C. Power: 9 - 30 VDC
 - D. Output: 4 mA at 12.7 psi
20 mA at full scale.
 - E. Accuracy: plus/minus 0.25 percent of full scale B.L.S.
 - F. Pressure Range: 50, 100, 200, 350, 520, 750 and 1000 psi sealed gauge.
 - G. Diameter: 7.1 in.
 - H. Heavy stainless steel 316 L body.
 - I. Cable: Heavy duty shield 2 conductors, submersible rated with strain relief device. 0.30 in. TPE alloy jacket and kevlar 130 lb. min. tensile strength.
 - J. Cable Length: Well depth plus length to terminal box with 10 feet slack coiled in terminal box.

2.21 SIGNAL CONVERTER/ISOLATION AMPLIFIER

- A. Manufacturers:
 - 1. MCR-C Series manufactured by Phoenix Contact.
 - 2. AKT Series manufactured by Wieland Manufacturing.
- B. Voltage to current and current to voltage conversion.

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

C. Current to current isolation amplifier.

2.22 ETHERNET SWITCH – FIVE (5) PORT

A. Manufacturer and Model:

1. MOXA EDS-828 Series Layer 3 Modular Managed Ethernet Switch
2. CISCO Industrial Ethernet (IE) 1000 Series Lightly Managed rugged ethernet switch.
3. Red Lion N-Tron 700 Series Managed Ethernet Switches
4. Or, approved equal.

B. Features:

1. Plug-n-Play, Ring Redundancy solution (recovery time < 300 ms)
2. 10/100BaseT(X) (RJ-45), 100BaseFX (SC optical fiber transceiver connection port).
3. Support IEEE 802.3/802.3u/802.3x.
4. Store and Forward switching process type.
5. 10/100M, Full/Half-Duplex, MDI, MDI-X auto-sensing.
6. SPAN/Port Mirroring
7. Alarm I/O

C. Specifications:

1. RJ-45 Ports: 10/100BaseT(X) auto MDI-X negotiation speed, F/H duplex mode, and auto MDI/MDI-X connection.
2. Fiber Ports: SFP Transceivers and connectors as required for speed and connection types.
3. LED Indicators
4. Power:

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CONDUIT, FITTINGS, AND BODIES

- a. External power supplies as required to power additional network modules.
- b. Input Voltage: 12 to 48 VDC
- c. Input Current (@ 24V): 2.1 A

D. Design:

- 1. Operating temperature ranges from 0 to 60°C, or extended operating temperature from -40 to 70°C.
- 2. IP30, rugged high-strength metal case.
- 3. For hazardous location (CLASS 1 DIV. 2)
- 4. DIN-Rail or panel mounting ability.

E. Execution:

- 1. For additional parts, provide switch with similar characteristics.
- 2. Provide Manufacturer's recommended power supply.
- 3. Install per Manufacturer's instructions.

F. Limited Warranty: Five (5) years.

2.23 ETHERNET SWITCH – MULTI-PORT – (NOT APPLICABLE)

2.24 FLOW-NO-FLOW SWITCH

A. Manufacturer and Model:

- 1. Flow Technology Uniprobe Flow-No-Flow Switch
- 2. Or pre-approved equal.

B. Specifications:

- 1. Flow Threshold Switch Point
- 2. Maximum No-Damage Flow Velocity
- 3. Response Time

CYPRESS FOREST PUD – WATER PLANT NO. 2 STORM DAMAGE AND REPAIRS

CONDUIT, FITTINGS, AND BODIES

4. Switch Capacity
5. Switch Configuration
6. Operating Temperature Range
7. Maximum Operating Pressure
 - a. UP01
 - b. SP01
8. Power Required
9. Construction of 316 Stainless Steel
10. NEMA 4X or Explosion-Proof Enclosure
11. Omni-Directional Flow Sensing
12. Clean-In-Place
13. Operates in corrosive or abrasive liquids and gases.

2.25 PANEL GAUGES

- A. Provide front flange, flush, panel mounted 6-inch diameter and with lower back mount type.
- B. Range:
 1. Water Pressure: 0 to 150 psi.
 2. Ground Storage Tank Level: 0 to 50 feet.
 3. Other measured parameter range plus 25 percent.
- C. Accuracy: 1 percent or better.
- D. Manufacturers:
 1. Marshal Town
 2. Or approved equal.

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CONDUIT, FITTINGS, AND BODIES

2.26 INTRUSION SWITCHES

A. Doors:

1. On all entrance doors for alarm switch and, on MCC and control panel doors for intrusion or light operation, install Model E700, DPDT switch as manufactured by ERSCE except where shown otherwise on plans.
2. MicroSwitch, applicable model, where indicated on plans.
3. Special Applications:
 - a. Where indicated on Plans for loose fitted doors and/or for areas where subject to damage, install GRI Model 4400 magnetic switches with stainless steel cable.

B. Overhead Rollup Doors:

1. For overhead door applications, install ADEMCO Model 958-2 Magnetic OHD Contractor, or approved equal.

2.27 DC/DC CONVERTER

- A. Manufacturer and Model: AGM Electronics, Group 4000 or, as pre-approved in writing.
- B. Supply Voltage: 8 – 90 VDC.
- C. Load Drive: 0 – 350 ohms.
- D. 2 or 4 wire, as required.
- E. 4 - 20 ma or 8 – 10 vdc, as required for inputs and outputs.
- F. Accuracy: Plus/minus 0.1 percent calibration.
- G. Adjustable signal offset and span.
- H. Outputs: Multiple, as indicated on plans or as required for circuit application.
- I. See Manufacturer's data sheets for additional requirements.

2.28 POSITION/DISPLACEMENT SENSOR

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CONDUIT, FITTINGS, AND BODIES

- A. Sensor: Macro Sensors Model HSDR 750 Hermetically Sealed DC-LVDT Position Sensor and Loop Powered LVDT Positioned Transmitter.
 - 1. DC-LVDT Sensor:
 - a. Plus/minus 15 VDC input, 0 to plus/minus 10 VDC output.
 - b. Non-linearity less than plus/minus 0.25 percent of FRO.
 - c. Range: Plus/minus 0.050 inch to plus/minus 10 inches.
 - d. Environmentally sealed to IEC IP.68.
 - 2. Loop Powered LVDT Transmitter:
 - a. 4 – 20 mA loop powered I/O.
 - b. Non-linearity less than plus/minus 0.5 percent of FRO.
 - c. Range: 1 inch to 10 inches.
 - d. Hermetically sealed for harsh environments.
- B. Macro Sensor DMC-A2-100 Dual Channel Controller: AC-LVDT controller with digital display and with RS232C/Ethernet/analog outputs.
- C. Macro Sensor Modular LVDT Signal Conditioner:
 - 1. Model: LVC-2412.
 - 2. DIN rail mounting.
 - 3. 4 – 20 ma output or 0 – 10 VDC output.
 - 4. 12 vdc or 24 VDC operating voltage.
 - 5. Temperature Range: 0° F to 160° F.
 - 6. Install per Manufacturer's instructions.
- D. Calibration and Settings:
 - 1. Calibration to be performed by Factory Representative.
 - 2. Field settings per Manufacturer's instructions.

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CONDUIT, FITTINGS, AND BODIES

- E. For Cla-Val positioning and position indication applications use Cla-Val Models CRL-33 and X117D respectively.

2.29 MULTIPLE CHANNEL ISOLATED SWITCH

- A. Manufacturer: Diversified Electronics.
- B. Model: ISO and ISL Series.
- C. Contacts: SPST-N.O. per channel.
- D. Temperature Range: -4° F to 135° F.
- E. LED indicators for each output.

2.30 AC CURRENT TRANSDUCER

- A. Manufacturer: HCS.
- B. Model: CR4170 Series.
- C. Output: 4 – 20 mA or 0 – 5 VDC, as required.
- D. Three (3) element AC current.
- E. Calibration: True RMS sensing.
- F. Temperature Range: 0 to 50 degrees Celsius.

2.31 IMPEDANCE MATCHING TRANSFORMER

- A. Manufacturer: Hammond Manufacturing
- B. Model: 802 and 803E
- C. 50 ohm to 600 ohm

2.32 ELECTRONIC VIBRATION SENSOR/SWITCH

- A. Manufacturer:
 - 1. Robertshaw
- B. Model:

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CONDUIT, FITTINGS, AND BODIES

1. 566-A2-E Velocity-Acceleration Vibration Monitor
- C. Outputs:
 1. One (1) SPST relay trip for alarm, one (1) SPST relay trip for shutdown, and 4-20 MA absolute analog signal.
- D. Scale:
 1. Coordinate with Pump/Motor Vendor for displacement ranges required.
- E. Input Power:
 1. 115 VAC, 60 Hz
- F. Enclosure:
 1. Epoxy coated NEMA 4
- G. Lockout Feature:
 1. Adjustable 15 second start up delay
- H. Accessories:
 1. Provide alarms as follows:
 - a. Alarm No. 1: Operates with adjustable time delay (0.5 to 15 seconds.) When a vibration signal continues to exceed the set point for as long as the time delay setting, the alarm actuates.
 - b. Alarm No. 2: Actuates when vibration signal exceeds set point. No time delay is available.
 - c. Latch Disable: Disables alarm latches. Alarms reset automatically when vibration level returns to normal from an alarm condition.
- I. Model 566 monitor, installed in SCADA cabinet door, or at each motor starter cabinet, as indicated on Plans.
- J. Input Signal:

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CONDUIT, FITTINGS, AND BODIES

1. Velocity:
 - a. Low Range: 0 to 1.5 in./sec RMS
 - b. High Range: 0 to 3 in./sec RMS
2. Acceleration:
 - a. Low Range: 0 to 5 G's RMS
 - b. High Range: 0 to 10 G's RMS

- K. Remote sensor for motor mounting.
- L. High temperature accelerometer/transmitter sufficient for use at motor housing temperature.
- M. Provide all necessary factory hardware for attachment to motor and for cable connections to junction box. Install sensors for both X and Y axis displacement on motor housing. Submit mounting detail for Engineer's approval.
- N. Provide program software to install in plant SCADA PC for analysis and trending of analog signal. To allow observation of entire frequency range of vibration transducer, filtering and gating of signal for display at operator's station. Program shall be furnished along with shop drawings and ready for SCADA programmer's use.

2.33 LIQUID LEVEL SENSOR

- A. Siemens Sitrans Model LC300
- B. 4-20 mA current loop circuit with power supply. Route to SCADA or controller I/O.
- C. Measure full depth of tank.
- D. Threaded or flange connection to match port or tank.
- E. Rod or rope probe with PFA jackets as applicable for conditions.
- F. Local LCD user interface where shown on plans.

2.34 SUBMERSIBLE PUMP PROTECTION MODULE

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CONDUIT, FITTINGS, AND BODIES

- A. Flight MiniCAS II: Model No. 83 58 57 (24 volt), 40-50 10 98 (120 volt); MiniCAS II/FUS Model No. 14-40 71 13 92 (24 volt).
- B. Module shall be capable of monitoring temperature via a thermal switch embedded in motor winding, and capable of detecting leakage via sensor located in pump.
- C. Temperature detection to operate Form “C” 10 amp contact, such that when wired into pump controls will shut down pump when over-temperature condition is detected.
- D. Leakage detection to operate Form “C” 10 amp contact, such that when wired into pump controls will initiate alarm.
- E. 20-30 VDC, 50-60 Hz with 24 volt external power supply, or 120 VAC, 5-60 control power source.
- F. LED indicators for over-temperature and leak indications.
- G. Manual reset pushbutton to interrupt power supply.
- H. Model No. 14-50 70 97 Socket
- I. Temperature Range: 0-50° C (32-123° F), Max 90% RH

2.35 MODBUS Ethernet Serial Server

- A. Manufacturer:
 - 1. B & B Electronics.
- B. Models:
 - 1. MESA1A, MES1B.
- C. Dimensions:
 - 1. MES1A/MES1B – 1.25 x 4.5 x 4.75 in (3.2 x 11.3 x 12.2 cm).
- D. Power Supply Requirements:
 - 1. 10VDC to 30VDC @ 3.6W.
- E. Power Consumption:
 - 1. 12VDC @300 mA.

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CONDUIT, FITTINGS, AND BODIES

- F. Operating Temperature:
 - 1. -20 to 80 °C (-4 to 176 °F).
- G. Humidity:
 - 1. 10% to 90% R.H. non-condensing.
- H. Ethernet:
 - 1. Single RJ-45 female (with built-in LED indicators).
 - 2. IEEE 802.3 10/100 Mbps auto-detecting, 10BaseT, 100BaseTX.
 - 3. TCP, UDP, DHCP, SNMP, TELNET, ICMP, ARP, TFTP, Modbus ASCII, Modbus RTU, Modbus/TCP
- I. Serial:
 - 1. 12V TVS for MES1A.
 - 2. MES1A – 9 pin D-type male (DB-9M).
 - 3. 5 V TVS for MES1B.
 - 4. MES1B removable screw terminal (5) block with screw down.
- J. Interface Lines Supported:
 - 1. MES1A – RS-232 TD, RD, GND.
 - 2. MES1B – RS-422-485 TDA(-), TDB(+), RDA(-), RDB(+), GND.
- K. Configuration Modes:
 - 1. Telnet, XPort Device Installer with integrated Telnet.
- L. Device Management:
 - 1. SNMP – RFC 1213-1215-1316-131.

2.36 LIGHTING CONTROL DEVICES

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CONDUIT, FITTINGS, AND BODIES

A. Photocells:

1. Provide photocell rated at 120 volt, 5 amp minimum, temperature range -40 to 150 degree F, weather proof outdoor use. Twist lock base where noted.
2. Manufacturers: Tork, GE, Woods or approved equal.

B. Lighting Contractors:

1. Provide multipole, 120/300/600 volt range as applicable with contacts rated at 10 to 100 amps as required by lighting load.
2. Manufacturers: Eaton, GE, Allen Bradley, or approved equal.

C. Enclosure:

1. Provide NEMA 1 enclosure for indoor use and NEMA 4X for outdoor use, or as indicated on plans. Outdoor enclosures to have no devices on outer door.

D. Selector Switches & Pilot Lights:

1. Provide Hand/Off/Auto selector switch as indicated on plans. See item 2.01 of this specification for acceptable manufacturers and models.

2.37 HYBRID VOLTAGE / CURRENT SENSOR MODULE

- A.** Provide a solid state hybrid voltage/current sensor module equal in quality to Potter Brumfield CR Series unit, to control and monitor VFD driven submersible pumps in event of “over temperature” conditions as shown on control diagram sheet of the construction plans. This is a proprietary monitor and control scheme that is designed for this specific project only. It is intended for use with Flygt pumps only and may not provide the protection required with other pump controls.

This control circuit replaces the standard Mini Cas unit provide with Flygt pumps and may not function with other manufactures pumps.

- B.** The pump shall be ordered without the standard Leak Detector system when this specific method of control is used. The pump shall contain only the temperature sensor switch manufactured by Thermik and installed inside pump by Flygt.
- C.** The controls shall operate in a manner as follows for VFD operated pumps:
1. Provide solid state hybrid voltage/current sensor module as manufactured by Potter Brumfield or equal for use with 12vdc power to pump motor

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CONDUIT, FITTINGS, AND BODIES

temperature sensor model SO6-140.05 manufactured by Thermik as supplied installed in Flygt grit pump. Circuit shall operate to sense current flow thru the temperature sensor and output a 4-20 am signal over a calibrated range that allows the SCADA PLC to determine motor temperature based on current flow. In addition, the sensor module shall provide a discrete signal output when sensor current is zero, indicating the sensor switch has opened at the high temperature limit setpoint. The sensor will reset internally when the motor temperature decreases as the motor cools.

2. The control circuit shall Lock Out when the sensor switch opens on high temperature, and requires operator manual reset before pump will restart. Contacts will inhibit the motor control circuit and also send an alarm to the control panel indicator light and to the SCADA PLC.
3. The 4-20 ma signal to the SCADA AO module shall be calibrated to temperature of each specific pump sensor. The PLC can inhibit the motor controls at any time before the temperature sensor switch is opened, and shall lock out the PLC pump VFD Call signal until reset at the PLC.

This allows two means to stop the pump in event temperature rise is greater than set at the PLC, or greater than the operating point of the temperature sensor internal switch to assure pump temperature is not ever excessive at any VFD controlled speed.

4. The sensor circuit shall operate in same in Hand or Auto control of the pump. The temperature monitoring circuit will be powered up when the pump HOA switch is turned to the Hand or Auto position. The circuit shall have a settling time after initiation of the activation relay as shown on the pump control diagram. The pump start time delay relay shall be set a value not less than the time it requires for the over temperature circuits to be fully activate to assure the pump Call controls function normally when the HOA switch is set. When the pump HOA is Off or when a specific pump VFD breaker is turned off, the over temperature circuit is to be deactivated.
- D. Controls manufacture shall perform field calibration tests based on test figures from manufacturer and shall confirm temperature readings are accurate based on current flow thru the over temperature sensor/switch provided with each pump. Pump manufacture is to provide certified calibration data for the current flow thru sensor over the range of pump operating temperatures.

2.38 TAGGING

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CONDUIT, FITTINGS, AND BODIES

- A. Provide Type 316 stainless steel tag on field-mounted units and permanently affix tag to unit.
- B. Include Engineer's tag number where listed in Control Diagrams.
- C. See Section 16195 – "Electrical Identification" for additional requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.
- B. Control Relay:
 - 1. Install panel control relays in I&C panel.
 - 2. Install motor starter control relays in MCC and wherever more rugged type relay required.

END OF SECTION

SECTION 16949

CELLULAR ROUTER

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements. Failure to do so will be at expense of Contractor and at no additional cost to Owner.
- C. Contractor shall contact local Factory Representative to verify all equipment purchased conforms to the requirements of this project. Failure to do so may result in equipment removal and replacement at Contractor’s expense. See Section 16012 – “Electrical Work,” for submittal requirements.

1.01 SUMMARY

- A. Section Includes: LAN-Cell 3 Mobile Cellular Router.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Proxicast.
- B. Written pre-approved equal

2.02 3G/4G CELLULAR ROUTER

- A. Cellular Router shall be Proxicast LAN-Cell 3, high performance mobile 3G/4G, with all related power supplies, cabling, mounting devices, adapters, Wi-Fi antenna, and documentation. Provide and install according to Manufacturer’s instructions, per Plans and Specifications, and to fit space in controls cabinet.
- B. Provide and install Verizon capable 3G/4G LTE USB modem.
- C. Provide and install Cellular Amplifier to boost signal reception. Include all required

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CELLULAR ROUTER

appurtenances for a complete operating system.

- D. Provide three (3) VPN client licenses, and all other license required for a complete communication link between stations shown on plans and indicated in specifications.
- E. Provide all required Wireless Air Cards for communications link. Air Cards are available separately on a carrier-to-carrier basis and shall be provided for the carrier specified, and as required for 3G access using the Proxicast LAN-Cell 2 kit.
- F. Provide outdoor rated antennas with length of cable required for connection to router or cards with antenna located in outdoor location shown on Plans, or for optimum signal reception at site. Antenna cables to be complete with SMA connector, or as required by devices supplied. Antenna shall have swivel base for adjustment of antenna. Multiband cellular antennas shall be rated 2 dm or better, as required for optimum signal strength.
- G. Router Characteristics:
 - 1. Open Upgradable Architecture: High Speed 3G/4G Modem Slot with Modem-Lock and External Antenna Ports
 - 2. Supports LTE, HSPA+ EV-DO Rev-A, EV-DO Rev-0, 1xRTT, HSUPA, HSDPA, UMTS, EDGE, GPRS USB Modems
 - 3. Enterprise-Class 3G/4G Router and WiFi (802.11 a/b/g) Wireless Features
 - 4. Four (4) Port 10/100 Ethernet LAN Switch + (1) 10/100 Ethernet WAN Port
 - 5. Full VPN, Client and Server Firewall and Security Functions
 - 6. Automatic Fail-Over Between 3G/4G Cellular and Ethernet WAN
 - 7. Built-In Cellular Cost Control Features
 - 8. Web Interface and SNMP
- H. Provide router, cards, software, firmware, accessories, and services for Electrical Engineer's use to remotely set-up, monitor, and observe control systems operation.
- I. Provide all equipment, devices, accessories, software, firmware, set-up, and programming of Owner's mobile laptop for access to SCADA system via the 3G/4G cellular network.

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- J. Provide “unlimited” monthly service from Provider. Activation shall be paid for by Contractor until end of 1 – year warranty period of contract, at which time Owner may continue service. Provide a Public Static IP address for each USB modem provided.

2.03 SUBMITTALS

- A. Submit shop drawing per requirements of Section 16012 – “Electrical Work.”

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, Contract Documents, and approved submittals.
- B. Provide Verizon cellular service that extends from date controls and/or SCADA systems are activated for testing and programming to end of 1-year warranty period of contract, after which time service contract shall be transferred to Owner.
- C. All installation and service costs through this period are at Contractor’s expense.
- D. Failure to active service at designated time will result in Owner’s Representative activating system, and all related costs, including person-hours and overhead, charged to Contractor.
- E. Any delay in activation of cellular router system installation will be at Contractor’s risk for all testing and engineering schedule changes required.
- F. Cellular router shall be activated and coordinated with Engineer prior to any controls inspections or testing by Engineer. Any delay in construction due to this provision is at Contractor’s risk.

3.02 OPERATION & MAINTENANCE (O&M) MANUALS

- A. Provide O&M manuals per requirements of Section 16012 – “Electrical Work,” Item 1.05 – “Operation and Maintenance (O&M) Manuals.”

3.03 WARRANTY

- A. Provide warranty per requirements of Section 16012 – “Electrical Work,” Item 3.06 – “Warranty.”

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3.04 TRAINING

- A. Provide training per requirements of Section 16012 – “Electrical Work,” Item 3.07 – “Training.”

END OF SECTION

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SECTION 16995
ELECTRICAL SYSTEM COMMISSIONING

PART 1 GENERAL

1.00 CONDITIONS

- A. This copyright protected © specification is issued confidentially for this specific project only. Reproduction of this document for any other purpose is prohibited.
- B. Refer to Section 16012 - “Electrical Work” for additional requirements.

1.01 DESCRIPTION

- A. The purpose of this section is to specify Divisions 11, 13, 15 and 16 responsibilities in the commissioning process, which are being directed by the TE. Other electrical system testing are required under the direction of the General Contractor, prior to start of the commissioning process.
- B. Description of equipment and systems included in the commissioning process are found in Specification sections 16012, 16013, 16014, 16484, 16482, 16484 and 16904.
- C. Commissioning requires the participation of the Contractor and subcontractors and equipment suppliers to ensure that all systems are operating in a manner consistent with the Contract Documents. The general equipment setup, testing and inspection requirements to be complete prior to start of commissioning process are detailed in the above listed Specification Sections. All work described in these specifications is to be finished and accepted prior to start of commissioning testing. The Contractor shall be familiar with all parts of the commissioning requirements and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.02 DEFINITIONS

- A. TE: “Test Engineer”
- B. Contractor: General Contractor

1.03 RESPONSIBILITIES

- A. Contractors: The commissioning responsibilities applicable to the Contractor, and subcontractors, and equipment suppliers are as follows.

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B. Construction and Acceptance Phases:

1. Include the all cost related to the electrical control system commissioning in the contract price.
2. Attend a commissioning scoping meeting and other necessary meetings scheduled by the TE to facilitate the commissioning process.
3. Contractors shall provide standard cut sheets and shop drawing submittals to the TE. These are the documents required under the terms of the construction contract.
4. Provide additional requested equipment installation and/or operation documentation for the O&M manual submittals to the TE for use in development of start-up and functional testing procedures.
 - a. The Commissioning Engineer or TE may request further documentation necessary for the commissioning process where original submittals or O&M Manuals are not adequate or lack complete information.
5. Contractor, subcontractors or supplier shall assist TE in clarifying the operation and control of commissioned equipment in areas where the submitted, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
6. Provide assistance to the TE in preparation of the specific functional performance test procedures. Equipment vendors or manufacturers shall review test procedures to ensure feasibility, safety, and equipment protection during commissioning testing, and shall provide all required alarm limits (in writing) to be used during the tests to assure no damage to equipment. It is the Contractors responsibility to assure safe equipment operation during testing and commissioning procedures.
7. Develop a plan for full start-up and initial checkout procedures using Manufacturer's recommended start-up procedures. Submit copy of Manufacturer's start-up procedures and other requested equipment documentation to TE for review.
8. During the start-up and initial checkout process, execute and document the electrical/mechanical/instrumentation related portions of the pre-functional checklists for all commissioned equipment.

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9. Perform and clearly document all completed pre start-up and system operational checkout procedures required by construction contract documents and, provide a copy to the TE prior to starting commissioning tests.
10. Address all current Engineer's inspection punch list items for electrical, mechanical and instrumentation installations.
11. Provide skilled, factory trained Technicians to execute setup and starting of equipment and to execute the functional performance demonstrations required by the construction documents prior to the commissioning process. Ensure that Technicians are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and provide problem resolutions in a timely manner so as to not delay start of commissioning activities. . Where a Technician will be absent during a prescheduled test, Contractor shall have replacement Technician, or shall provide 48 hour notice to Engineer and TE. Any absence of testing personnel, subcontractors or suppliers may result in rescheduling of tests and may result in additional Commissioning costs at Contractors expense.
13. Perform functional performance testing under the direction of the TE for specified equipment during commissioning testing. Assist the TE in interpreting the monitored data, as necessary to confirm proper operation of equipment being tested.
14. Correct deficiencies (differences between specified and observed performance during commissioning) as interpreted by the TE and/or Engineer and be prepared to retest the equipment where requested to do so.
15. Prepare O&M manuals according to the Construction Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions based on results of commissioning tests.
16. Prepare Record as-built drawings for all drawings and final as-builts for Contractor generated drawings, based on field marked red-line drawings, and based on results of commissioning testing.
17. Provide training of the Owner's operating personnel as described in Specification sections of the contract documents. TE or TS Representative may be present during training sessions.
18. Coordinate with Equipment Manufacturers to determine specific testing conditions to maintain the validity of the warranty.

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19. Power System Studies:

- a. Provide power system studies that include a complete short-circuit study, equipment evaluation study and protective device coordination study based on the installed electrical distribution system, is required under the construction contract. These studies shall be undated if commissioning testing requires any variation from original studies.
- b. Include in the study updates, all portions of the electrical distribution system from the main service circuit breaker(s) and from alternate generator source of power in the electrical distribution system under study.
- c. Cover normal system operating configuration plus any plausible alternate configurations and operations that could result in maximum fault conditions occurring.
- d. Short-Circuit Study:
 - 1) Perform all short circuit studies using the E-TAP software package as produced by Operation Technology Inc.
 - 2) Provide electronic copy of studies in format that is compatible with other E-TAP versions.
- e. Provide Arc Flash Study and signage per NEC Requirements.
- f. Notify the Engineer of any problem areas or inadequacies in the electrical distribution system equipment.

PART 2 PRODUCTS (not applicable this project.)

PART 3 EXECUTION

3.01 COMMISSIONING PRETESTING PROCEDURES

- A. All electrical and mechanical equipment and systems will be tested individually prior to conducting the official Commissioning testing to assure each system is functional, all setpoint settings are correct, all signal paths to test computers are complete and accurate and, all systems respond to commands from the Commissioning station PC. All pretesting will be recorded at the Commissioning station PC.

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At this point, any equipment or systems operation not already demonstrated to Engineer and Owners Representative as required under the Contract shall be demonstrated.

- B. After all pretests are complete and all systems are confirmed as operating properly, the final Commissioning test will be scheduled by the TE and Contractor. After this point in time, no adjustments or alterations to any equipment or systems will be allowed, unless approved by the TE. If time permits, the pretesting is to be completed immediately, or the following day.

As with all previous inspections and testing, the Contractor, subcontractors, equipment supplier Representatives will be required to be present to assist in event problems occur during the test routines. The final test routine will be a computer controlled automatic test and will not be interruptible without halting the complete test routine, in which case, testing will start from the beginning.

- C. After successful completion of the computer controlled automatic tests, and after analysis of test data is completed and acceptable, the Engineer will notify the Owners Representative that the Commissioning procedures are over and the plant is operating in an acceptable manner.

3.02 START-UP

- A. The Electrical Contractors shall follow the start-up and initial checkout procedures listed in the responsibilities described in this section. Division 16 – “Electrical” has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

3.03 FUNCTIONAL PERFORMANCE TESTS – (NOT APPLICABLE)

- A. Functional testing is intended to begin upon completion of the complete instrumentation and control systems. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the TE and CM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre-functional checklists.

3.04 TESTING DOCUMENTATION, NON-CONFORMANCE, AND APPROVALS – (NOT APPLICABLE)

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3.05 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Division 16 – “Electrical” shall compile and prepare documentation for all equipment and systems covered in Division 16 – “Electrical” and deliver to the TE for inclusion in the O&M manuals.
- B. The TE shall receive a copy of the O&M manuals for review.

3.06 TRAINING OF OWNER PERSONNEL

- A. The Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Division 16 Specifications for additional details.
- B. The TE shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.
- C. Contractor: The Contractor shall have the following training responsibilities:
 - 1. Provide the TE with a training plan two (2) weeks before the planned training according to the outline described in Division 16 Specifications.
 - 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 - 3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including start-up, shut down, alarms, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate Trade or Manufacturer’s Representative shall provide the instructions on each major piece of equipment. This person may be the Start-Up Technician for the piece of equipment, the installing Contractor or Manufacturer’s Representative. In-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

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6. The training sessions shall follow the operation and maintenance manual and illustrate, whenever possible, the use of the O&M manuals for reference.
7. Training shall include:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M Manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Cover common troubleshooting problems and solutions.
 - d. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
 - e. Discuss any peculiarities of equipment installation or operation.
 - f. Classroom sessions may include the use of overhead projections, slides, video and audio taped material as might be appropriate.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut down, and any emergency procedures and maintenance of all pieces of equipment.
9. The Electrical Contractor and vendor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the instrumentation and control systems.
10. Training shall occur after functional testing is complete, unless approved otherwise by the Engineer.
11. Training Scope: The Electrical Contractor, vendor and manufacturer's representative shall provide training on each system and piece of equipment according to the following schedule and as specified in the associated Specification sections of the construction contract.
 - a. Electrical Power Systems
 - b. Electrical Controls

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- c. Emergency Generator Operations (simulate power failure)
- d. SCADA System
- e. Instrumentation System
- f. SSRV Controllers (SSRV)
- g. Alarms
- h. Level Transmitter Controls
- i. Air Compressor System Operation
- j. SCADA Master Station Operation
- k. Power Monitor
- l. Autodialer
- m. Autosensory Controls
- n. Operation of SCADA System, Controls, MCC & Generator
- o. Set point adjustments of all devices an equipment
- p. Maintenance of SCADA System, Controls MCC & Generator
- q. Operation of all other equipment and controls installed in this project.

END OF SECTION