

B R O W N S V I L L E PUBLIC UTILITIES BOARD

Bid # 057-22 WASTEWATER PUMPING STATION UPGRADES – PACKAGE 1- LS 9, 10, 11, and 43

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

August 2022

BOARD MEMBERS

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PACKET 1- WASTEWATER PUMPING STATIONS-LIFT STATIONS 9, 10, 11, and 43



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PACKET 1- WASTEWATER PUMPING STATIONS-LIFT STATIONS 9, 10, 11, and 43

	Specification Sections Sealed:
	Division 13
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8/19/2022	
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	H. G. DOYLE, JR.
	STEDETET
cpty, Inc.	KG Dongle Marine
Texas Architectural firm # BR 2019	EXP.6/30/23 8/19/251
CP&Y, Inc.	THE SEAL AND SIGNATURE APPEARING ON THIS SHEET WERE
Texas Registered Engineering Firm F-1741	AUTHORIZED ON AUGUST 19, 2022.

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PACKET 1- WASTEWATER PUMPING STATIONS-LIFT STATIONS 9, 10, 11, and 43



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LEGAL NOTICE AND INVITATION TO BID #B057-22

Sealed bids will be received by the PUBLIC UTILITIES BOARD of the City of Brownsville, Texas ("BPUB", "OWNER"), at the PUB Purchasing Department office; 1155 FM 511, Olmito, TX 78575 **until 5:00 PM, local prevailing time, on October 5, 2022** for the Project described in the Contract Documents and Specifications entitled:

Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43

Bids received after this time will not be considered.

Bids will be publicly opened and read aloud on October 6, 2022 at 10:00 AM. Bidders are invited to attend the bid opening via conference call-in at (956) 214-6020.

The Work in general includes, but is not limited to:

- 1. Lift Station 9
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pumps, rails, level sensors, and piping.
 - (iii) Replace force main valves, and appurtenances.
 - b. Remove/replace electrical
 - c. Construct new electrical building
 - d. Sitework rehabilitation
- 2. Lift Station 10
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pumps, rails, level sensors, and piping.
 - (iii) Replace force main, valves, and appurtenances.
 - b. Remove/replace electrical
 - c. Sitework rehabilitation
- 3. Lift Station 11
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pump rails, level sensors, and piping.
 - (iii) Replace force main, valves, and appurtenances.
 - b. Remove/replace electrical
 - c. Sitework rehabilitation
- 4. Lift Station 43
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.

- (ii) Replace pump rails, level sensors, and piping.
- (iii) Replace force main, valves, and appurtenances.
- b. Remove/replace electrical
- c. Sitework rehabilitation

Copies of the Contract Documents and Specifications may be obtained at the following website <u>https://www.brownsville-pub.com/rfp_status/open/</u>. A non-mandatory pre-bid conference shall be held at the BPUB Purchasing Department via conference call at (956) 214-6020 at 10:00 AM, local prevailing time, on September 21, 2022.

Each bid, in duplicate, shall be enclosed in a sealed envelope and shall be plainly marked on the outside of the envelope: **"#B057-22 Packet 1- Wastewater Pumping Station Upgrades** Lift Stations 9, 10, 11, and 43 October 5, 2022, 5:00 PM". This envelope shall be addressed to Diane Solitaire; Brownsville Public Utilities Board; Purchasing Department; 1155 FM 511 Olmito, Texas 78575.

Each bid shall constitute an offer to the Board, as outlined therein, and shall be irrevocable for at least ninety (90) calendar days after the time announced for the opening thereof.

Each bid shall be accompanied by a Certified or Cashier's check payable to the order of the Brownsville Public Utilities Board, City of Brownsville, Texas for a sum not less than five (5%) percent of the total amount bid. In lieu of a check, a Bid Bond with a Corporate Surety licensed to do business in the State of Texas, may be submitted in an amount not less than five (5%) percent of the total amount bid conditioned that the BIDDER will pay the BPUB, as mutually agreed to liquidated damages, and not as a penalty, the amount specified in the Bond, unless he enters into a BPUB contract in accordance with his bid. BIDDER is required to execute a contract and furnish a Performance Bond, Payment Bond and a Certificate of Insurance. If the BIDDER fails to execute the contract and to furnish satisfactory Performance and Payment Bonds and Insurance Certificates within ten (10) calendar days from the date on which he is notified that his bid has been accepted, the amount of his check or bid bond shall be forfeited to the BPUB as mutually agreed to liquidated damages, and not as a penalty. **No bid will be considered if the Bid Security is not submitted**.

The BPUB will not be responsible in the event that the U.S. Postal Service or any other courier system fails to deliver the sealed bids to the Brownsville Public Utilities Board, Purchasing Office by the given deadline above. No bids will be accepted via facsimile or electronic transmission.

The BPUB specifically reserves the right to reject any or all bids, to waive irregularities or informalities in any or all bids and to accept any bid which is deemed to be in the best interest of the Board or to reject the bids. The award will be made to the responsive and responsible bidder submitting the lowest bid as determined by the BPUB.

Equal Opportunity in Employment - All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin. Bidders will be required to comply with the President's Executive Order No. 11246, as amended by Executive

Order 11375, and as supplemented in Department of Labor regulations 41 CFR, Part 60. The requirements for bidders and contractors under this Order are explained in the Specifications.

Diane Solitaire Purchasing Department (956) 983-6366

INSTRUCTIONS TO BIDDERS Please submit this page upon receipt

Acknowledgment Form Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43 #B057-22

For any clarifications, please contact Diane Solitaire at the Brownsville Public Utilities Board, Purchasing Department at (956) 983-6366 or e-mail: <u>dsolitaire@brownsville-pub.com</u>

Please e-mail this page upon receipt of the bid package or legal notice. If you only received the legal notice and you want the bid package mailed, please provide a method of shipment with account number in the space designated below.

Check one:

- () Yes, I will be able to send a bid; obtained bid package from website.
- () Yes, I will be able to send a bid; please email the bid package. Email:
- () Yes, I will be able to send a bid; please mail the bid package using the carrier & account number listed below:

Carrier:	
Account:	

() No, I will not be able to send a bid for the following reason:

If you are unable to send your bid, kindly indicate your reason for "No bid" above and return this form **via email to <u>dsolitaire@brownsville-pub.com</u>**. This will ensure you remain active on our vendor list.

Date			
Company:			
Name:			
Address:			
City:	State:	Zip Code:	
Phone:	Fax:		
Email:			

Special Instructions

Contract Information

• Interpretation

Questions concerning terms, conditions, and technical specifications should be directed to:

Diane Solitaire, Materials/Warehouse Manager email: dsolitaire@brownsville-pub.com

Tentative Time Line

- 1. September 12, 2022 through October 5, 2022 Vendor bid preparation.
- 2. October 5, 2022 at 5:00 PM Vendor must submit bid, in duplicate, sealed in an envelope to:

Diane Solitaire, Materials/Warehouse Manager 1155 FM 511 Olmito, TX 78575

Bid **#B057-22** Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43 Due October 5, 2022 at 5:00 PM

The above noted information must be included on bid envelope and on any carrier's envelope/package. The Brownsville Public Utilities Board will not be held responsible for missing, lost or late mail. Brownsville Public Utilities Board will not accept electronic transmissions or facsimiles of sealed bids.

- 3. September 21, 2022 Pre-Bid Conference at 10:00 AM
- 4. September 27, 2022 Last day to submit questions
- 5. October 6, 2022 Open bids at 10:00 AM
- 6. October 7 through October 21, 2022 Evaluate bids
- 7. October 31, 2022 Deadline to provide final recommendations for Board approval.
- 8. November 14, 2022 Send to Utilities Board for formal and possible Contract award approval

• "Or Equal"

Brand name and/or manufacturer's references used in this Request are descriptive – not restrictive – they are intended to generally indicate type and quality desired. Brands of like nature and quality will generally be considered. If bidding on other than referenced Specifications, please provide complete descriptive information of said material/equipment article. BPUB also reserves the legal right to specify a "sole source" component if such component is critical for integration to a larger

BPUB assembly and alternative manufactured items will not meet the design and/or performance needs of the BPUB, in BPUB's sole discretion.

• Pricing

Bid unit prices on BPUB estimated quantities specified, extend and show total. In case of errors in extension, unit prices expressed in written words and not numerals, shall govern. Prices shall remain firm throughout the Contract.

All fields (UNIT PRICE & TOTAL PRICE) in the Bid Schedule must be filled in. The data must be complete to identify any bidding brand called for specifically.

Failure to submit any of the above information with the sealed bid may disqualify bid as non-responsive.

• Contractor Representative

The successful contractor agrees to send a personal representative with binding authority for the company to the Brownsville Public Utilities Board, upon request, to make any minor clarifications or adjustments and/or assist with coordination of all transactions as needed to allow Contract entry.

• Quality of Products

All material and equipment items specified must be new, in first class condition, including containers suitable for shipment and storage. No substitutions in standard grades or lesser quality will be accepted.

• Determining Factors for Award

- 1. Price
- 2. Responsibility of contractor to perform the intended work and responsiveness to the bid request.
- 3. Compliance with requirements of the Technical Specifications
- 4. Quality of performance on previous work on similar contracts
- 5. Recent successful completion of similar projects
- 6. BPUB financial and legal responsibility evaluations of any identified teaming arrangements involving significant joint ventures, sub-contractors and suppliers
- 7. Safety record will be considered when determining the responsibility of the bidder

• Contract with Vendor/Entity Indebted to BPUB

It is a policy of the BPUB to refuse to enter into a contract or other transaction with an individual, sole proprietorship, joint venture, Limited Liability Company or other entity indebted to BPUB.

• Vendor ACH (Direct Deposit) Services

The BPUB has implemented a payment service for vendors/contractors by depositing the contract payment directly to the contractor's/vendor's bank account. Successful vendor(s)/contractors will

be required to receive payments directly through Automated Clearing House (ACH) in lieu of a paper check. The awarded vendor must agree to receive payments via ACH (Direct Deposit).

• Tax Identification Number (TIN)

In accordance with IRS Publication 515, aW9 form, or a W8 form in cases of a foreign vendor, will be required of all vendors doing business with the Brownsville PUB. If a W9 or W8 form is not made available to Brownsville PUB, the first payment will be subject to income tax withholding at a rate of 28% or 30% depending on the U.S. status and the source of income as per IRS Publication 515. **The W9 or W8 form must be included with bid response.** Attached are sample forms.

• Taxes

The City of Brownsville and its Brownsville Public Utilities Board are exempt from Federal Excise Tax, State Tax and local sales Taxes. Do not include any taxes in the bid proposal. If it is later determined that tax was included in the bid it will not be included in the tabulation or any awards. Tax exemption certificates will be furnished by BPUB upon request.

• Signing of Bid

Failure to sign bid will disqualify it. Person signing bid should show title or legal authority to bind their firm to a Contract.

• EEOC Guidelines

During the performance of this Contract, the contractor agrees not to discriminate against any employee or applicant for employment because of race, national origin, age, religion, gender, sexual preference, marital or veteran status, or physically challenging condition.

• Living Wage Statement

On April 16, 2007, the BPUB Board of Directors approved a local "living wage" policy that requires all Contractors and Subcontractors performing 100% <u>Non</u>-Federally funded Work for the BPUB, to pay a minimum wage rate of \$8.00/hour. The BPUB requires that all Contractors and Subcontractors comply with this policy. Otherwise, the BPUB adopts the Federal Department of Labor Wage scales for Cameron County on 100% <u>Non</u>-Federally funded projects as specified later herein in the Supplementary Conditions.

• Contract and Purchase Order

The services shall be completed in a timely manner as specified in the specifications. A Contract for the services will be placed into effect by means of a purchase order and/or Construction Agreement issued by the Brownsville Public Utilities Board after tabulation and final Contract approval by the Board.

• Brownsville Public Utilities Board Rights

- 1. If only one or no bid is received by "submission date", the BPUB has the right to reject, re-bid, accept and/or extend the bid by up to an additional two (2) weeks from original submission date.
- 2. The right to reject any/or all bids and to make award as it may appear to be advantageous to the Brownsville Public Utilities Board.
- 3. The right to hold bid for 90 calendar days from submission date without action, and to waive all informalities in any bid.
- 4. The right to extend the total bid beyond the original 90-calendar day period prior to an award, if agreed upon in writing by all parties (BPUB and vendor/contractor) and if bidder/vendor holds original bid prices firm.
- 5. The right to terminate for cause or convenience all or any part of the unfinished portion of the Project resulting from this solicitation within seven (7) calendar days written notice; <u>for cause</u>: upon default by the vendor/contractor, for delay or non-performance by the vendor/contractor; or if it is deemed in the best interest of the BPUB <u>for BPUB's convenience</u>. (See, General Conditions Article 15)

• Corrections

Any interpretation, correction, or change of the Invitation to Bid will be made by written ADDENDUM. Changes or corrections will be issued by the Brownsville PUB Purchasing Department. Addenda will be emailed to all who have returned the Bid Acknowledgment form. Addenda will be issued as expeditiously as possible. It is the responsibility of the vendors/contractors to determine whether all Addenda have been received. It will be the responsibility of all respondents to contact the Brownsville PUB prior to submitting a response to the Invitation to Bid to ascertain if any/all Addenda have been issued, and to obtain any all Addenda, execute them, and return Addenda with the response to the Invitation to Bid. Addenda may also be posted on BPUB's website.

1. RECEIPT AND OPENING OF BIDS:

The Brownsville Public Utilities Board, City of Brownsville, Texas (hereinafter called OWNER), invites bids on the form attached hereto, all blanks of which must be appropriately filled in, in ink, for Project entitled Bid #B057-22 Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43.

The OWNER may consider informal and non-responsive, any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids. Any bid may be withdrawn by vendor/contractor prior to the above scheduled time for the opening of bids or OWNER authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No BIDDER may withdraw a bid within at least ninety (90) calendar days after the actual date of the opening thereof.

2. INSPECTION OF SITE:

Each BIDDER shall visit the Project site of the proposed Work and fully acquaint himself with the existing conditions there relating to construction and labor, and shall fully inform himself as to the facility involved, the difficulties and restrictions attending the performance of the Contract. The BIDDER shall thoroughly examine and familiarize himself with the Drawings, Technical Specifications, and all other Contract Documents. The Contractor, by the execution of the Contract, shall in no way be relieved of any obligation under it due to his failure to receive or examine any form or legal instrument, or to visit the Project site and acquaint himself with the conditions there existing and the OWNER will be justified in rejecting any claim for extra time, or compensation, or both, based on facts regarding which Contractor should have been on notice as a result of such a diligent Project site visitation. Visits to the Project site shall be arranged by calling David Ramirez, P.E., P.Eng., Senior Civil Engineer, at telephone no. (956) 346-5970.

3. PREPARATION OF BID AND USE OF SEPARATE BID FORMS:

These Contract Documents include a complete set of bidding documents. The BIDDER shall copy all Documents listed in the table of contents under the heading BIDDING DOCUMENTS and shall submit two sets (original signed and one signed photocopy) of his bid on these forms. A bid shall be comprised of the BIDDING DOCUMENTS completed by the BIDDER plus supplemental information required by the Specifications and Contract Documents.

If any of the information submitted as part of the bid is considered to be proprietary by the BIDDER, he shall conspicuously identify such intended confidential information in his bid. BPUB is subject to the provisions of the Texas Public Information Act and cannot legally guarantee confidentiality of submittals and may need to consult with its legal counsel and the Texas Attorney General in rendering decisions on any requested disclosures.

a) Preparation. Each bid shall be carefully prepared using the bid and bid data forms included as a part of the bidding documents. Entries on the bid and bid data forms shall be typed, using dark black ink, or legibly written in black ink. All prices shall be stated in written words and numeric figures, except where the forms provide for figures only. In case of discrepancy, especially in any sum total extensions, the amount shown in written words will generally prevail over numeric unit prices.

The BIDDER shall acknowledge, in the space provided in the bid form, receipt of each Addendum issued for the Specifications and Documents during the bidding period.

The BIDDER shall assemble all drawings, catalog data, and other supplementary information necessary to thoroughly describe Work, materials and equipment covered by the bid, and shall attach such supplemental information to the copies of the Specifications and documents submitted.

b) Signatures. Each BIDDER shall sign the bid with his usual signature and shall give his full business title and address. The BIDDER's corporate name stated on the bid

shall be the exact legal name of the firm. The names of all persons signing should also be typed or printed below the signature.

Bids by partnerships shall be signed with the partnership name followed by the signature and designation title/officer of one of the partners or other authorized representative. A complete list of the partners shall be included with the bid.

Bids by a corporation shall be signed in the official corporate name of the corporation, followed by the signature and designation of the "president," "secretary," or other legally appropriate person authorized to bind the corporation.

A bid by a person who affixes to his signature the word "president," "secretary," "agent," or other designation, without disclosing his principal corporation, will be rejected. Satisfactory evidence of the legal authority of the officer signing on behalf of the corporation shall be furnished. Bidding corporations shall designate the state in which they are incorporated and the address of their principal office.

c) Submittal. The original signed bid (and its accompanying photocopy) shall be transmitted to arrive at the designated BPUB address not later than the date and time stipulated in the Legal Notice and Invitation to Bid.

Submit the original signed bid (and its accompanying photocopy) to:

Brownsville Public Utilities Board 1155 FM 511 Olmito, Texas 78575 Attention: Ms. Diane Solitaire Purchasing Department

Each bid must be submitted in duplicate as stated above (original signature and photocopy), in a sealed envelope bearing on the outside the name of the BIDDER, his address, and the name of the Project for which the bid is submitted. If forwarded by mail, the sealed envelope containing the bid itself must be enclosed in another mailing envelope addressed as specified in the bid form.

4. METHOD OF BIDDING: UNIT PRICE AND LUMP SUM.

Prices shall be firm, not subject to qualification, condition or adjustment. Prices shall be in United States dollars. Prices shall be lump sum, except where unit prices are requested by the bid forms. When unit price items are required by the bid, the unit prices for each of the several items in the bid of each BIDDER shall include its pro-rata share of overhead, so that the sum of the products obtained by multiplying the quantity shown for each item, by the unit price bid, represents the total bid. Any bid not conforming to that requirement may be rejected as informal and non-responsive. The special attention of all BIDDERS is called to this provision, (See: General Conditions paragraph 11.9) for should conditions make it necessary to revise any unit price quantities, generally, a fifteen (15%) percent plus or minus tolerance quantity limit will be fixed for such increased or decreased quantities for which no extra compensation will be allowed, provided the

net monetary value of all such additive and subtractive changes in quantities of such items of work pursuant to public competitive bidding statutes (i.e., difference in cost) shall not cumulatively increase or decrease the original Contract Price by more than twenty-five (25%) percent. A proposed decrease only, that exceeds twenty-five (25%) percent of the original Contract Price must be agreed to in writing in advance by the Contractor.

5. **DISCLOSURE BY BIDDER:**

Each BIDDER shall submit with the bid documents, on the form furnished for that purpose, his Pre-Bid Disclosure Statement showing his experience record in performing the type of work embraced in the contract, his organization and equipment available for the work contemplated, and, when specifically requested by the OWNER, a detailed financial statement. The OWNER shall have the right to take such steps as it deems necessary, including telephonic contact to other owner references, to determine the ability and responsibility of the BIDDER to perform his obligations under the Contract and the BIDDER shall be responsive in furnishing the OWNER all such information and data for this purpose as it may request. OWNER reserves the right to reject any bid where an investigation of the available evidence or information does not satisfy the OWNER that the BIDDER is responsible to properly carry out the terms of the Contract. This shall also apply to any proposed subcontractor(s).

6. SUBCONTRACTS:

The BIDDER is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this Contract must be acceptable to the OWNER, and that a Pre-Bid Disclosure Statement for each proposed subcontractor must also be submitted with the bid documents.

7. **BID SECURITY:**

Each bid must be accompanied by a certified or cashier's check, or a bid bond prepared on the form of the bid bond attached hereto, duly executed by the BIDDER as principal, and having as surety therein a surety company approved by the OWNER, and authorized to do business in the State of Texas, in the amount of not less than five (5%) percent of the total bid amount, but not less than \$2,500.00. Such checks, or bid bonds will be returned to all except the three lowest BIDDERS within fifteen (15) calendar days after the opening of bids, and the remaining checks, or bid bonds will be returned promptly after the OWNER and the accepted successful BIDDER have executed the Contract or if no award has been made, within Ninety (90) calendar days after the date of the opening of bids. The bid security will be returned upon demand of the BIDDER at any time thereafter, so long as he has not been notified of the acceptance of his bid.

8. ADDENDA AND INTERPRETATIONS:

No oral interpretations by OWNER and its representatives shall be binding upon OWNER as to the meaning of the Plans, Specifications, Contract Documents, or other pre-bid documents.

Every request for such interpretation should be made in <u>writing</u>, addressed to Diane Solitaire, BPUB Purchasing Department. Any interpretation, correction, or change to the Invitation to Bid will be made by ADDENDUM. Changes or corrections will be issued by the Brownsville PUB Purchasing Department only and will be on file at the BPUB Department mentioned above. Addenda will be emailed to all who have returned the acknowledgement form. Addenda will be issued as expeditiously as possible. It is the BIDDER's responsibility to inquire as to any Addenda issued and failure of any BIDDER to receive any such Addenda or interpretation shall not relieve such BIDDER from any obligation under his bid as submitted. All Addenda so issued shall become part of the Contract Documents. Addenda may also be posted on BPUB's webpage.

Exceptions or conditional qualifications by the BIDDER to the Plans, Technical Specifications, Contract Documents, or other pre-bid documents <u>will not be permitted at the time of submitting</u> the Bid Documents to the OWNER, and any exceptions or conditional qualifications taken by BIDDER, will automatically deem the bid conditional and non-responsive and subject to OWNER rejection.

9. FACSIMILE MODIFICATION:

Any BIDDER may modify (not originally submit) his bid by facsimile communication at any time <u>prior to</u> the scheduled bid closing time for receipt of bids, provided such communication is received by the OWNER, in the BPUB Purchasing Department, <u>prior to</u> the bid closing time, and provided further, the OWNER is satisfied that a written confirmation of the facsimile modification, over the original signature of the BIDDER, was also mailed <u>prior to</u> the bid closing time. The facsimile communication should <u>not reveal the total bid price</u>, but only should provide the clarification, addition or subtraction, or other modification, so that the final bid prices or terms intended will <u>not</u> be known by the OWNER, until the original sealed bid is opened and the Bidder's intended modification computed by OWNER.

Revised bids submitted before the opening of bids, whether forwarded by mail or facsimile, if representing an increase in excess of two percent (2%) of the original bid submittal, must have the bid security (bid bond or check) adjusted accordingly; otherwise the bid will not be considered responsive.

If the written and originally signed confirmation of a bid revision is not received within three (3) calendar days after the bid closing time, no consideration will be given to any proposed adjustment contained in the facsimile modification.

10. TIME FOR RECEIVING BIDS:

Bids received prior to the advertised hour of opening will be securely kept sealed by BPUB. The officer whose duty it is to open them will decide when the specified time has arrived, and no bid received thereafter will be considered; except that when a bid arrives by mail after the time fixed for opening, <u>but before the public reading of all other bids is completed</u>, and it is shown to the satisfaction of the OWNER that the non-arrival on time was due solely to delay in the mails for which the BIDDER was not responsible, such bid will be received and considered.

BIDDERS are cautioned that, while facsimile modifications of bids may be received as provided above, such modifications, if not explicit and if in any sense subject to misinterpretation, shall make the bid so modified or amended, subject to rejection for non-responsiveness.

11. OPENING OF BIDS:

At the time and place fixed for the public opening of bids, the OWNER will cause to be opened and publicly read aloud every bid received within the time set for receiving bids, irrespective of any irregularities therein. BIDDERS and other persons properly interested in a bid (subcontractors, suppliers, etc.) may be present, in person or by representative, but shall carry identification and present same to BPUB as requested.

12. WITHDRAWAL OF BIDS:

Bids may be withdrawn on written, facsimile or electronic transmission request dispatched by the BIDDER in time for delivery in the normal course of business <u>prior to</u> the time fixed for bid opening; provided, that written confirmation of any facsimile withdrawal over the signature of the BIDDER is placed in the mail and postmarked prior to the time set for bid opening. The bid security of any BIDDER withdrawing the bid in accordance with the foregoing conditions will be returned promptly.

13. AWARD OF CONTRACT: REJECTION OF BIDS:

The Contract will be awarded to the <u>responsive and responsible BIDDER</u> submitting the lowest bid complying with the conditions of the Legal Notice and Invitation for Bids. The BIDDER to whom the award is made will be notified at the earliest possible date. The OWNER, however, reserves the right to reject any and all bids and to waive any informality in bids received, whenever such rejection or waiver is in BPUB's interest.

The OWNER reserves the right to consider as not responsible, any BIDDER who does not habitually perform with his own forces the major portions of the Work involved in construction of the improvements embraced in this proposed Contract. This provision is meant to prevent wholesale assignment and "brokering" of awarded contracts.

14. EXECUTION OF AGREEMENT: PERFORMANCE AND PAYMENT BOND:

Subsequent to the Notice of Award and within ten (10) calendar days after the prescribed forms are presented for signature, the successful BIDDER shall execute and deliver to the OWNER an Agreement in the form included in the Contract Documents in such number of copies as the OWNER may require.

Having satisfied all conditions of award as set forth elsewhere in these Documents, the successful BIDDER shall, within the period specified in the preceding paragraph, furnish a Performance Bond and Payment Bond, in accordance with the following parameters:

- a.) For a Contract in excess of \$100,000.00, a Performance Bond shall be executed in the full amount of the Contract, conditioned upon the faithful and timely performance of the Work in accordance with the Plans, Specifications, and Contract Documents. Said Bond shall be solely for the protection of the OWNER.
- b.) For a Contract in excess of \$50,000.00, a Payment Bond shall be executed in the full amount of the Contract, solely for the protection of all proper claimants supplying labor and material in the prosecution of the Work provided for in the Contract, for the use of each such claimant perfecting a proper and timely claim. Payment Bonds are required under Texas law, since <u>no mechanics' liens are allowed against BPUB's public property assets</u>.

When bonds are required, they shall serve as security for the faithful performance of the Contract, and for the payment of all persons, firms or corporations to whom the Contractor may become legally indebted to for labor, materials, tools, equipment, or services of any nature, including utility and transportation services employed or used by him in performing the Work. Such bonds shall be in the same form as that included in the Contract Documents and shall bear the same date as, or a date subsequent to that of the Agreement. The current power of attorney for the person who signs for any surety company shall be attached to such bonds. These bonds shall be signed by a guaranty or surety company legally authorized to do business in the State of Texas and appearing on the most recently issued (as of the date of bid opening) federally qualified U. S. Treasury Circular 570 List of Approved Sureties.

The failure of the successful BIDDER to execute such Agreement and to supply the required bonds and insurance certificates within ten (10) calendar days after the prescribed forms are presented for signature, or within such extended period as the OWNER may grant in writing, based upon reasons determined sufficient by the OWNER, shall constitute a default, and the OWNER may either award the Contract to the next lowest responsive and responsible BIDDER, or re-advertise for bids, and may charge against the defaulting BIDDER the difference between the amount of the defaulted bid and the amount for which a final Contract for the Work is subsequently executed, irrespective of whether the amount thus due exceeds the amount of the bid bond. If a more favorable bid is received by re-advertising, the defaulting BIDDER shall have no claim against the OWNER for a bid bond refund.

15. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT:

The successful BIDDER, upon his failure or refusal to execute and deliver the Contract, Bonds and insurance certificates required within ten (10) calendar days after he has received BPUB notice of the acceptance of his bid, shall forfeit to the OWNER, as mutually agreed to liquidated damages (and not as a penalty) for such failure or refusal, the security provided in the bid bond or otherwise deposited with his bid.

16. TIME OF COMPLETION AND LIQUIDATED DAMAGES:

BIDDER agrees by submission of his bid that PERFORMANCE TIME IS OF THE ESSENCE OF THIS CONTRACT and further agrees to commence Work on the date to be specified in a

BPUB written "Notice to Proceed" issued by the OWNER and to Substantially Complete the Project as provided in Article 3 of the Construction Agreement.

BIDDER agrees by submission of his bid to pay as mutually agreed to liquidated damages, and not as a penalty, the sum as provided in said Construction Agreement, Article 3.

17. NOTICE OF SPECIAL CONDITIONS:

Attention is particularly called to those parts of the Contract Documents and Specifications which address the following:

- A. Access to Work Inspection and testing of materials.
- B. Insurance requirements.
- C. Indemnification by Contractor
- D. Wage and Hour Provisions.
- E. State Sales and Use Tax Exemption Provisions.
- F. Subsurface Geologic Conditions.
- G. Certification Regarding Debarment, Suspension and other Responsibility Requirements (EPA 5700-49).

18. LAWS AND REGULATIONS:

The BIDDER's attention is directed to the fact that all applicable federal, State and local laws, statutes, ordinances, codes and the rules and regulations of all authorities having jurisdiction over construction of the Project, as may be periodically amended, shall apply to the Contract throughout, and they will be mutually deemed to be included in the Contract, the same as though herein written out in full.

19. EQUAL EMPLOYMENT OPPORTUNITY:

Attention of BIDDERS is particularly called to the requirement for ensuring that employees and applicants for employment are not discriminated against because of their race, religion, gender, age, sexual preference, physically challenging condition or national origin.

Equal Opportunity in Employment - All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin. Bidders will be required to comply with the President's Executive Order No. 11246, as amended by Executive Order 11375, and as supplemented in Department of Labor regulations 41 CFR, Part 60. The requirements for bidders and contractors under this order are explained in the General Conditions.

20. PRE-BID CONFERENCE:

A pre-bid virtual or in-person meeting between the OWNER, prospective bidders, suppliers, etc., will be held to answer any questions concerning the Work. No Addenda will be issued at this meeting. Subsequent thereto, if necessary to clear up any written questions, a written Addendum will be issued by the OWNER to all pre-bid conference attendees. The pre-bid meeting will be

held at the place, time and date indicated in the Legal Notice. Attendance at the Pre-Bid Conference is <u>NOT mandatory</u> for prospective bidders.

21. SUBMITTAL OF TRENCH SAFETY DESIGN:

For Work involving excavations generally deeper than five (5) feet within narrow trenches, the apparent low BIDDER shall provide the OWNER with a Trench Safety System Plan and a certificate signed and sealed by a Registered Professional Engineer licensed by the State of Texas, within twenty-one (21) calendar days after the date of the opening of Bids prior to award of the Contract. Failure to timely comply may disqualify BIDDER.

22. INFORMATION TO BE SUBMITTED WITH BID:

Each BIDDER shall submit with his bid, the following:

a) <u>Equipment and Materials</u>. In addition to the information submitted on the bid and bid data forms, each BIDDER shall submit all specifications, preliminary drawings, and similar descriptive information necessary to describe completely the equipment and materials he proposes to furnish.

The bid shall be based on using new equipment and materials, which comply with the Specifications and Contract Documents in every respect, unless existing equipment is specifically noted by OWNER for reuse. If alternate or "equal" equipment and materials are indicated in the bid, it shall be understood that the OWNER will have the option of selecting any one of the alternates so indicated and such selection shall not be a cause for extra contractor compensation or extension of time. <u>OWNER specifically reserves the legal right to specify "sole source" equipment</u> or materials in the Specifications when unique circumstances warrant.

b) <u>Contractor's Field Organization and Safety Record</u>.

- (i) An organization chart showing the names of field management, supervisory, technical personnel, and number of employees/workforce available and the details of the management, supervisory, and technical organization which he proposes to use for this Project. The successful BIDDER's organizational concept will be subject to the review and acceptance of the OWNER.
- (ii) The experience record of the Contractor's field superintendent(s) shall be submitted with the bid.
- (iii)The Contractor's job-safety record summary for the previous five (5) years
- (iv)The two most recent year's independently audited Financial Statements
- (v) List of three (3) projects completed by CONTRACTOR of both similar size and scope over the past five (5) years

23. PREFERENCE LAW:

Bid evaluations will take into consideration any Preference Laws of the State of Texas, and any reciprocity laws of other states as they may be addressed by current Texas law.

24. SUBSURFACE GEOLOGIC CONDITIONS:

Each BIDDER shall be responsible for determining prior to bidding, the types of subsurface materials which will be found. If test borings have been made on the Project site by the BPUB or its consultants, the locations and logs of the test borings are bound as an appendix to these Specifications and Documents.

It is to be expressly understood and acknowledged by the BIDDER, that any information on subsurface geology made available by OWNER for BIDDER'S convenience shall <u>not be a part</u> of the Contract Documents and there is no expressed or implied guarantee of the data given, nor of the interpretation thereof.

All <u>excavation</u> for this Project will be <u>unclassified</u> and the BIDDER shall be responsible for investigating and satisfying himself of subsurface geologic conditions <u>(including the presence or likelihood of encountering soils requiring dewatering</u>, rock or rock-like materials) prior to submitting his bid, which shall include any and all costs BIDDER associates with avoiding, managing or removing said subsurface geologic conditions without claim for extra compensation against OWNER.

Should BIDDER desire to perform on-site investigations prior to submitting his bid, he is required to notify the OWNER of such intentions and obtain OWNER's written permission not less than 48 hours prior to performing the investigation. BIDDER is responsible for obtaining all related insurance and necessary permits from all sources.

25. DISPOSAL OF EXCESS MATERIALS:

After completion of this Project there may be in some instances an excess of spoil material or waste material left over. In such cases where there is an excess of material, BIDDER shall load and haul it away from the job site and dispose of it in a legal manner so as not to: trespass; adversely impact any protected wetlands; adversely impact the 100 year flood plain; adversely impact any endangered species; or otherwise create drainage diversions or impoundments. No extra remuneration for this Work will be allowed.

26. EROSION AND SEDIMENT CONTROL MEASURES:

The BIDDER is expected to conduct his Work in such a manner as to minimize any soil erosion or sediment runoff from the construction site. Earth cuts and fills shall have smooth, flat side slopes, as generally indicated on the PLANS, to preclude erosion of the soil. Such operations should be timed consistent with the actual need for doing the Work and only to leave raw, unprotected surfaces for a minimum of time.

Existing lawns are to remain intact as far as practical. Such areas as are disturbed shall be duly restored by the BIDDER to as good as or better than original condition using the same type of grass, shrubs, or cover as the original. The BIDDER shall be responsible for correcting any erosion that occurs at his sole cost without claim for extra compensation.

As construction progresses, and in accordance with State and federal laws regulating stormwater runoff and management from construction sites greater than five acres in size, if applicable, (See: Section 405 of the Water Quality Act of 1987, Section 402(P) as amended), and at locations where erosion with sediment runoff occurs or is likely to occur, the BIDDER shall construct temporary ditches, perimeter siltation screens, retainage levees, drains, inlets, or other works to manage, prevent, or correct the possible conditions. Upon completion of the Work, such facilities shall be removed by contractor.

During construction, the BIDDER shall take the necessary precautions to see that erosion is controlled and sediment runoff is prevented so as to protect the quality of any neighboring water bodies.

27. SAFETY PROVISIONS:

BIDDER shall provide barricades, flares, warning signs, and/or flagmen so that danger and inconvenience to the OWNER, public, and any job site working personnel, will be mitigated. In addition to any other requirements of the Contract Documents, the BIDDER shall be responsible for familiarity and compliance with all Federal (OSHA), State, railroad and local safety rules, laws and requirements.

28. PROTECTION OF PROPERTY AND EXISTING UTILITIES:

Within developed areas, all public and private property along and adjacent to the BIDDER'S operations, including roads, driveways, lawns, yards, shrubs, drainage gradients, and trees, shall be adequately protected, and when damages occur, they shall be repaired, replaced, or renewed or otherwise put in a condition equal to, or better than, that which existed before the BIDDER caused the damage or removal.

An attempt has been made by BPUB and the ENGINEER to locate and show all known existing utilities on the PLANS, <u>but the possibility remains strong that some underground utilities may</u> <u>exist that have not been shown</u>. The BIDDER, through mandatory contact with local utility owners, shall keep himself informed and take such precautions as necessary to avoid utility damage and unsafe working conditions for employees.

29. WAGES AND HOURS:

The most recent wage rate determination from the U.S. Department of Labor for Cameron County, Texas as amended within the previous three (3) years and as locally adopted by the BPUB, is a part of the Supplementary Conditions and controls minimum wage, hour and any fringe benefits, with the exception that <u>no wage shall be paid below \$8.00 as established locally by the BPUB</u>.

A copy of the appropriate (building and/or heavy/highway) wage rate schedule(s) must be posted at the job site in both English and Spanish and kept posted in a conspicuous place on the site of the Project at all times during construction. The BIDDER shall familiarize himself with the included General and Supplementary Conditions Section entitled "Wage and Labor Standard Provisions - 100% Non-Federally Funded Construction." Copies of the current pre-bid wage rate schedule(s) are included in the Contract Documents, but the responsibility for initial posting and keeping same posted, rests upon the BIDDER.

30. WARRANTY/GUARANTEE:

The BIDDER shall <u>warranty and guarantee</u> the Work, equipment and materials for a period of at least one (1) year after date of final acceptance in writing by the OWNER. During this period, the BIDDER shall make any repairs and/or replacements of defective equipment and materials and corrections of Work due to poor workmanship or manufacturing, all as may be required for full compliance with the General Conditions, Plans and Specifications. This combined workmanship quality guarantee, and <u>minimal equipment and materials warranty</u>, shall apply to all matters reported by the OWNER in writing within said one (1) year period and this post-construction guarantee/warranty period shall be included in the coverage period set forth in the Performance Bond.

31. STATE SALES AND USE TAX EXEMPTION:

Pursuant to 34 Texas Administrative Code 3.291, in order for the Brownsville PUB to continue to benefit from its status as a State Sales and Use Tax Exempt Organization. Construction contracts must be awarded on a "separated contract" basis. A "separated contract" is one that distinguishes the value of the tangible personal property (materials such as pipe, bricks, lumber, concrete, paint, etc.) to be physically incorporated into the Project realty, from the total Contract Price. Under the "separated contract" format, the Contractor in effect becomes a "seller" to the Brownsville PUB of materials that are to be physically incorporated into the Project realty. As a "seller", the Contractor will issue a "Texas Certificate of Resale" to the supplier in lieu of paying the sales tax on materials at the time of purchase. The Contractor will also issue a "Certificate of Exemption" to the supplier demonstrating that the personal property is being purchased for resale and that the resale is to the Brownsville PUB, which is a sales tax exempt entity under UTCA Tax Code Section 151.309(5). Contractors should be careful to consult the most recent guidelines of the State Comptroller of Public Accounts regarding the sales tax status of supplies and equipment that are used and/or consumed during Project Work (gas, oil, rental equipment), but that are not physically incorporated into the Project realty. Such items are generally not tax exempt. Contractors that have questions about the implementation of this statute are asked to inquire directly with the State Comptroller of Public Accounts, Tax Administration Division, State of Texas, Austin, Texas 78774. Bidders will not include any federal taxes in bid prices since the City of Brownsville and Brownsville PUB are exempt from payment of such federal taxes. "Texas Certificates of Exemption". "Texas Certificates of Resale" and "Texas Sales Tax Permits" are forms available to the Contractor through the regional offices of the State Comptroller of Public Accounts.

BID

#B057-22 BPUB Purchasing Department 1155 FM 511 Olmito, Texas 78575 Due: October 5, 2022 at 5:00 PM

Bid of ______ hereinafter called BIDDER, a corporation organized and existing under the laws of the State of ______, or, a partnership, or an individual doing business as ______.

To the Brownsville Public Utilities Board of the City of Brownsville, Texas, hereinafter called OWNER.

Gentlemen:

The undersigned BIDDER, in compliance with your Invitation to Bid for the **Packet 1-Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43**, having read and examined the Plans and Specifications with related Contract Documents and visited the site of the proposed Work, and being familiar with all of the federal, state and local conditions surrounding the construction of the proposed Project, including the availability of materials and labor, hereby proposes to furnish all labor, materials, equipment and supplies, and to construct the Project in accordance with the Contract Documents, within the time set forth herein, and at the Total Base Bid Amount prior to OWNER options on additive/deductive alternates of: <u>(in words and numeric figures)</u>

. These price(s) are to cover all

expenses incurred in performing the Work required under the Contract Documents, of which this bid is a part. These price(s) are firm and shall not be subject to adjustment, provided this Bid is accepted by OWNER within ninety (90) calendar days after the time set for BPUB receipt of bids.

BIDDER hereby agrees to commence Work under this Contract on or before a date to be specified in a written "Notice to Proceed" to be issued by the OWNER, and to then fully complete the Project within the times established in Article 3 of the Construction Agreement. BIDDER further agrees to pay as liquidated damages, not as a penalty, for failure to do so, the sum(s) established in Article 3 of the Construction Agreement.

BIDDER agrees to perform all Work for which he contracts as described in the Technical Specifications and as shown on the Plans, for the prices indicated on the following Bid Form.

BID SCHEDULE BASE BID #B057-22 BROWNSVILLE PUBLIC UTILITIES BOARD

The Bidder, in compliance with the Invitation for Bids for the **Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43,** having examined the scope of work and written Specifications, hereby proposes to furnish construction services for the following Unit prices and lump sums.

LIFT STATION 9

ITEM	DESCRIPTION	Est. Qty	Unit	Unit Price (Written Unit Price in Words)	Unit Price	Total Price
9-1	Lift Station Demolition (Pumps, Piping, Valves, Hatches)	1	LS	Dollars and Cents	\$	\$
9-2	Electrical Demolition	1	LS	Dollars and Cents	\$	\$
9-3	Site Demolition and Prep	1	LS	Dollars and Cents	\$	\$
9-4	New 6' Cedar Wood Fence and Rolling Gate	1	LS	Dollars and Cents	\$	\$
9-5	Station Sign	1	EA	Dollars and Cents	\$	\$
9-6	Hardscape Gravel	254	SY	Dollars and Cents	\$	\$
9-7	Renovate Concrete Bench and Coat Interior of Wet Well	1	LS	Dollars and Cents	\$	\$

9-8	Mag Meter Vault	1	EA	Dollars and Cents	\$ \$
9-9	Pumps (Includes Power Cable, Discharge Pipe Connection, Anchors, And Guide Rails)	2	EA	Dollars and Cents	\$ \$
9-10	Discharge Piping (Includes All Bends and Fittings)	1	LS	Dollars and Cents	\$ \$
9-11	Valves- Plug and Check	8	EA	Dollars and Cents	\$ \$
9-12	Small Access Hatch	1	EA	Dollars and Cents	\$ \$
9-13	Pump Access Hatches	3	EA	Dollars and Cents	\$ \$
9-14	Backflow Preventer and Hose Bib	1	EA	Dollars and Cents	\$ \$
9-15	Electrical Building and Concrete Foundation	1	LS	Dollars and Cents	\$ \$
9-16	Lift Station Electrical Equipment	1	LS	Dollars and Cents	\$ \$

9-17	Electrical Conduits	1	LS	Dollars and Cents	\$ \$
9-18	Submersible Transducer	1	EA	Dollars and Cents	\$ \$
9-19	Ultrasonic Level Sensor	1	EA	Dollars and Cents	\$ \$
9-20	Bypass Pumping	1	LS	Dollars and Cents	\$ \$
9-21	Barricades, Signs and Traffic Handling	1	LS	Dollars and Cents	\$ \$
9-22	Mobilization (Maximum of 10%)	1	LS	Dollars and Cents	\$ \$

LIFT STATION 10

ITEM	DESCRIPTION	Est. Qty	Unit	Unit Price (Written Unit Price in Words)	Unit Price	Total Price
10-1	Lift Station Demolition (Pumps, Piping, Valves, and Hatches)	1	LS	Dollars and Cents	\$	\$
10-2	Electrical Demolition	1	LS	Dollars and Cents	\$	\$
10-3	Station Sign	1	EA	Dollars and Cents	\$	\$
10-4	Renovate Bench and Coat Interior of Wet Well	1	LS	Dollars and Cents	\$	\$
10-5	Pumps (Includes Power Cable, Discharge Pipe Connection, Anchors, and Guide Rails)	2	EA	Dollars and Cents	\$	\$
10-6	Discharge Piping (Includes All Bends, Fittings and Gauges- Pump Discharge To F.M. Tie-In)	1	LS	Dollars and Cents	\$	\$
10-7	Valves- Plug and Check	4	EA	Dollars and Cents	\$	\$
10-8	Valve Vault Vent Pipe	1	EA	Dollars and Cents	\$	\$

10-9	Pump Access Hatch	1	EA	Dollars and Cents	\$ \$
10-10	Backflow Preventer and Hose Bib	1	EA	Dollars and Cents	\$ \$
10-11	Lift Station Electrical Equipment	1	LS	Dollars and Cents	\$ \$
10-12	Electrical Conduits	1	LS	Dollars and Cents	\$ \$
10-13	Submersible Transducer	1	EA	Dollars and Cents	\$ \$
10-14	Ultrasonic Level Sensor	1	EA	Dollars and Cents	\$ \$
10-15	Bypass Pumping	1	LS	Dollars and Cents	\$ \$
10-16	Barricades, Signs and Traffic Handling	1	LS	Dollars and Cents	\$ \$
10-17	Mobilization (Maximum of 10%)	1	LS	Dollars and Cents	\$ \$

LIFT STATION 11

ITEM	DESCRIPTION	Est. Qty	Unit	Unit Price (Written Unit Price in Words)	Unit Price	Total Price
11-1	Lift Station Demolition (Pumps, Piping, Valves, Lid, Hatches, and Valve Vault)	1	LS	Dollars and Cents	\$	\$
11-2	Electrical Demolition	1	LS	Dollars and Cents	\$	\$
11-3	Site Demolition and Prep	1	LS	Dollars and Cents	\$	\$
11-4	Station Sign	1	EA	Dollars and Cents	\$	\$
11-5	Renovate Concrete Bench and Coat Interior of Wet Well	1	LS	Dollars and Cents	\$	\$
11-6	Discharge Pipe Support Pad and concrete drive extension	1	LS	Dollars and Cents	\$	\$
11-7	Pumps (Includes Power Cable, Discharge Pipe Connection, Anchors, And Guide Rails)	2	EA	Dollars and Cents	\$	\$
11-8	Discharge Piping (Includes All Bends, Fittings and Gauges- Pump Discharge To F.M. Tie-In)	1	LS	Dollars and Cents	\$	\$

11-9	Valves- Plug and Check	4	EA	Dollars and Cents	\$ \$
11-10	Adjustable Pipe Supports	4	EA	Dollars and Cents	\$ \$
11-11	Air and Vacuum Valve	1	EA	Dollars and Cents	\$ \$
11-12	Well Vent Pipe & 30 Ft Pole	1	EA	Dollars and Cents	\$ \$
11-13	Wet Well Lid	1	EA	Dollars and Cents	\$ \$
11-14	Pump Access Hatch	1	EA	Dollars and Cents	\$ \$
11-15	Backflow Preventer and Hose Bib	1	EA	Dollars and Cents	\$ \$
11-16	Electrical Canopy and Foundation	1	LS	Dollars and Cents	\$ \$
11-17	Lift Station Electrical Equipment	1	LS	Dollars and Cents	\$ \$
11-18	Electrical Conduits	1	LS	Dollars and Cents	\$ \$
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11-19	Submersible Transducer	1	EA	Dollars and Cents	\$ \$
11-20	Ultrasonic Level Sensor	1	EA	Dollars and Cents	\$ \$
11-21	Bypass Pumping	1	LS	Dollars and Cents	\$ \$
11-22	Barricades, Signs and Traffic Handling	1	LS	Dollars and Cents	\$ \$
11-23	Mobilization (Maximum of 10%)	1	LS	Dollars and Cents	\$ \$

LIFT STATION 43

ITEM	DESCRIPTION	Est. Qty	Unit	Unit Price (Written Unit Price in Words)	Unit Price	Total Price
43-1	Lift Station Demolition (Pumps, Piping, Valves, Lid, Hatches)	1	LS	andCents	\$	\$
43-2	Electrical Demolition	1	LS	andCents	\$	\$
43-3	Site Demolition and Prep	1	LS	andCents	\$	\$
43-4	Station Sign	1	EA	andCents	\$	\$
43-5	Hardscape Gravel	1	LS	andCents	\$	\$
43-6	Renovate Concrete Bench and Coat Interior of Wet Well	1	LS	andCents	\$	\$
43-7	Pumps (Includes Power Cable, Discharge Pipe Connection, Anchors, And Guide Rails)	2	EA	andCents	\$	\$
43-8	Discharge Piping (Includes All Bends, Fittings and Gauges- Pump Discharge To F.M. Tie-In)	1	LS	andCents	\$	\$

43-9	Valves- Plug and Check	4	EA	andCents	\$ \$
43-10	Wet Well Lid	1	EA	andCents	\$ \$
43-11	Pump Access Hatch	1	EA	andCents	\$ \$
43-12	Backflow Preventer and Hose Bib	1	EA	andCents	\$ \$
43-13	Lift Station Electrical Equipment	1	LS	andCents	\$ \$
43-14	Electrical Conduits	1	LS	andCents	\$ \$
43-15	Submersible Transducer	1	EA	andCents	\$ \$
43-16	Ultrasonic Level Sensor	1	EA	andCents	\$ \$
43-17	Bypass Pumping	1	LS	andCents	\$ \$

43-18	Barricades, Signs and Traffic Handling	1	LS	andCents	\$ \$
43-19	Mobilization (Maximum of 10%)	1	LS	andCents	\$ \$

SUBTOTAL LS 9: \$					
SUBTOTAL LS 10: \$					
SUBTOTAL LS 11: \$					
SUBTOTAL LS 43: \$					
[OTAL AMOUNT OF BID (ITEMS 9-1 - 43-19): \$					

(written in words)

NOTE: Quantities are estimated. The Brownsville PUB reserves the right to increase or decrease quantities as allowed by Texas law (plus or minus twenty-five (25%) percent and as deemed necessary by OWNER, without impacting the quoted unit prices. Prospective bidders are encouraged to visit and assess the existing Project site and structures prior to submitting a bid.

BIDDER Acknowledges receipt of the following Addenda:

SUBCONTRACTORS. The undersigned BIDDER proposes that he will be responsible to perform major portions of the Work at the Project site with his own forces and that specific portions of the Work not performed by the undersigned will be subcontracted and performed by the following subcontractors.

Work Subcontracted	Name of Subcontractor

Bid amounts are to be legibly shown in both words and figures. In case of discrepancy, the unit price amount written in words will govern.

The above lump sum and unit prices shall include all labor, materials, excavation, bailing, shallow groundwater dewatering, shoring, removal, backfill, overhead, profit, insurance, etc., to cover the finished Work of the several kinds called for.

BIDDER understands that the OWNER reserves the right to reject any or all bids and to waive any informalities in the bidding and to elect to opt for any additive or deductive alternates in arriving at a final Contract price.

BIDDER agrees that this bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled bid opening.

The undersigned hereby declares that only the persons or firms interested in the bid as principal or principals are named herein, and that no other persons or firms than are herein mentioned have any interest in this Bid or in the Contract to be entered into; that this Bid is made without connection with any other person, company, or entities likewise submitting a bid or bid; and that it is in all respects for and in good faith, without collusion or fraud.

Seal affixed here if BID is by a Corporation:

Respectfully submitted,

Title

Address

Attest:_____

BID BOND

STATE OF	Ş	
	ş	KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF	ş	

 THAT WE, the undersigned,
 as Principal, and

 ________as Surety, are hereby held and firmly bound unto the

 BROWNSVILLE PUBLIC UTILITIES BOARD OF THE CITY OF BROWNSVILLE, TEXAS,

 Obligee, as OWNER in the penal sum of _______for the

 payment of which, well and truly to be made, we hereby jointly and severally bind ourselves,

 successors and assigns.

Signed, this ______ day of ______, 20__.

The Condition of the above obligation is such that whereas the Principal has submitted to the OWNER a certain BID attached hereto and hereby made a part hereof to enter into a Contract in writing, for construction of the Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43

NOW, THEREFORE,

- (a) If said BID shall be rejected, or
- (b) If said BID shall be accepted and the Principal shall execute and deliver a Contract in the form of Construction Agreement attached hereto (properly completed in accordance with said BID) and shall timely furnish any Payment and Performance Bonds required for his faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall timely furnish proper Insurance Certificates, and shall in all other respects perform the Agreement created by the BPUB acceptance of said BID,

then this obligation shall be void. Otherwise the same shall remain in full force and effect, it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BID BOND shall be in no way impaired or affected by an extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto legally set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed, and these presents to be signed by their legally authorized officers, the day and year first set forth above.

Signed, this _____ day of _____, 20__.

Principal

Surety

By:_____

IMPORTANT - Surety companies executing BONDS must be legally authorized by the State Board of Insurance to transact business in the State of Texas, and be currently listed as approved federal sureties in the most recently issued (as of the date of bid opening) edition of the U. S. Treasury Circular 570.

CONTRACTOR'S PRE-BID DISCLOSURE STATEMENT

All questions <u>must</u> be answered or your bid may be deemed non-responsive and subject to rejection. The data given must be clear and comprehensive. <u>This statement must be notarized</u>. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional relevant information he desires.

1. This Pre-Bid Disclosure Statement is submitted to the Brownsville Public Utilities Board by:

a Corporation,	_ a Partnership,	a Texas .	Joint Venture, or	an Individual.
Address:			Contractor's Te	lephone #:
City		State	Zip Co	ode

2. Years in business under present business name: _____

3. Years of experience in construction work of the type called for in this Contract as: A General Contractor _____, A Subcontractor _____.

4. What projects has your organization completed? List most recent FIRST.

Contract	Type of Work	Date Completed	Owners Name and Address	Amount

5. What projects does your organization have under way as of this date?

Contract	Type of Work	Date Completed	Owners Name and Address	Amount

6. Have you ever failed to complete any work awarded to you?

____Yes ____No. If "Yes", state where and why. _____

7. Are you at present in any binding arbitrations and/or lawsuits involving construction work of any type?

____Yes ____No. If "Yes", explain: ______

8. Explain in detail the manner in which you have inspected the work and jobsite proposed in this contract:

9. Explain in detail your plan or layout for performing the work proposed in this contract:

10. If this contract is awarded to you, your company's office administrative manager for the work will be Mr. (Ms.)______, and your resident construction superintendent will be Mr. (Ms.)______.

11. What experience in this type of work does the individual designated as resident superintendent above have?

12. What portions of the work do you intend to subcontract?_____

13. What equipment do you <u>own</u> or <u>lease</u> that is available for the proposed work?

Quantity	Description, Size Capacity, Etc.	Condition	Years in Service	Present Location
-	1			

14. Have you received firm offers from all suppliers or manufacturers for <u>all</u> major items of material and/or equipment within the Base Bid Amount used in preparing your bid? ___ Yes ___ No

15. Attach resumes for the principal members of your organization, including the officers as well as the proposed superintendent for the project.

Credit available: \$_____ Bank Reference: _____

Bonding Capacity available: \$_____

The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by either the Owner's Engineer or Owner in verification of the recitals comprising this Pre-Bid Disclosure Statement.

The signatory of this questionnaire guarantees the truth and accuracy of all statements herein made and all answers herein expressed.

Dated this _____ day of ______, 20__.

By: _____

Title:_____

STATE OF _____

COUNTY OF _____

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

Notary Public My commission expires: _____

SUBCONTRACTOR'S PRE-BID DISCLOSURE STATEMENT

All Subcontractor questions <u>must</u> be answered or the <u>General Contractor's Bid may be</u> <u>deemed non-responsive and subject to rejection</u>. The data given must be clear and comprehensive. <u>This statement must be notarized</u>. If necessary, questions may be answered on separate attached sheets. The prospective Subcontractor may submit any additional relevant information he desires.

1. This Pre-Bid Disclosure Statement is submitted to the Brownsville Public Utilities Board by:

____a Corporation, ____a Partnership, ____a Texas Joint Venture, or ____an Individual.

 Address:
 Contractor's #:

 City
 State
 Zip Code

2. Years in business under present business name:

3. Years of experience in construction work of the type called for in this Contract as: A General Contractor _____, A Sub-contractor _____.

4. Have you ever previously worked as a subcontractor for this General Contractor? ______ Yes; ______ No; If yes, list three most recent projects in which your company has served as a subcontractor to this General Contractor.

5. What projects has your organization completed? List most recent FIRST.

Contract	Type of Work	Date Completed	Owners Name and Address	Amount

6. What projects does your organization have under way as of this date?

Contract	Type of Work	Date Completed	Owners Name and Address	Amount
			1	1

7. Have you ever failed to complete any work awarded to you?

____Yes ____No. If "Yes", state where and why. _____

8. Are you at present in any binding arbitrations and/or lawsuits involving construction work of any type?

____Yes ____No. If "Yes", explain: ______

9. Explain in detail the manner in which you have inspected the work and jobsite proposed in this contract:

10. Explain in detail your plan or layout for performing the work proposed in this contract:

11. If this subcontract is awarded to you by the general contractor, your company's office administrative manager for the work will be Mr. (Ms.) ______, and your resident construction superintendent will be Mr. (Ms.)

12. What experience in this type of work does the individual designated as resident superintendent above have?

13. What portions of the work do you intend to subtier subcontract?

14. What equipment do you own that is available for the proposed work?

Quantity	Description, Size Capacity, Etc.	Condition	Years in Service	Present Location
	Γ			

15. Have you received firm offers from suppliers or manufacturers for all major items of material and/or equipment within the price totals used in preparing your subcontractor bid? __Yes __No

16. Attach resumes for the principal members of your organization, including the officers as well as the proposed superintendent for the project.

Credit available: \$_____ Bank Reference:_____

Bonding Capacity available: \$_____

The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by either the Owner's Engineer or Owner in verification of the recitals comprising this Subcontractor Pre-Bid Disclosure Statement. The signatory of this questionnaire guarantees the truth and accuracy of all statements herein made and all answers herein expressed.

Dated this _____ day of ______, 20___.

By: _____

Title: _____

STATE OF _____

COUNTY OF _____

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

Notary Public My commission expires: _____

REQUIRED FORMS CHECKLIST

NAME	FORM DESCRIPTION	SUBMITTE	SUBMITTED WITH BID	
		YES	NO	
	Acknowledgement Form			
	Debarment Certificate			
Required Forms				
(if applicable)	Ethic Statement			
	Conflict of Interest Questionnaire			
	Residence Certification Form			
	Bid Schedule/Cost sheet completed and signe			
Special Instructions	Cashier Check or Bid Bond of 5% of Total			
(if applicable)	Amount of Bid			
	OSHA 300 Log			
	Contractor Pre-Bid Disclosure completed,			
	signed and notarized			
	Sub-Contractor Pre-Bid Disclosure completed	1,		
	signed, and notarized			
References	Complete the Previous Customer Reference			
	Worksheet for each reference provided			
Addenda				

The following documents are to be submitted as a part of the Bid/RFP/RFQ document

Prospective Bidders are respectfully reminded to completely read and thoroughly respond to the BPUB Instructions for Bidders and Pre-Bid Disclosure Statement. When BPUB evaluates the Bids, it reviews indices regarding the prospective contractors' responsibility to perform the project based upon prior job performances for BPUB and other public owners. Additionally, BPUB carefully reviews the prospective contractors' responsiveness to the BPUB Bid Advertisement. Bidders should thoroughly check their submittal for completeness prior to responding to BPUB. Do not imbalance your Bid line items to overload portions of the work. Remember to answer all written questions in the Pre-Bid Disclosure Statement and then notarize it when signing. Bidders are often required to submit OSHA 300 Logs from prior job performance records as well. BPUB can, has, and will reject Bids that fail the responsibility and/or responsiveness standards so as to protect the integrity of the bidding process for all participants. The Bidding community's compliance with these guideline standards will be appreciated by the BPUB.

ETHICS STATEMENT (Complete and return with bid)

The undersigned bidder, by signing and executing this bid, certifies and represents to the Brownsville Public Utilities Board that bidder has not offered, conferred or agreed to confer any pecuniary benefit, as defined by (1.07 (a) (6) of the Texas Penal Code, or any other thing of value as consideration for the receipt of information or any special treatment of advantage relating to this bid; the bidder also certifies and represents that the bidder has not offered, conferred or agreed to confer any pecuniary benefit or other thing of value as consideration for the recipient's decision, opinion, recommendation, vote or other exercise of discretion concerning this bid, the bidder certifies and represents that bidder has neither coerced nor attempted to influence the exercise of discretion by any officer, trustee, agent or employee of the Brownsville Public Utilities Board concerning this bid on the basis of any consideration not authorized by law; the bidder also certifies and represents that bidder has not received any information not available to other bidders so as to give the undersigned a preferential advantage with respect to this bid; the bidder further certifies and represents that bidder has not violated any state, federal, or local law, regulation or ordinance relating to bribery, improper influence, collusion or the like and that bidder will not in the future offer, confer, or agree to confer any pecuniary benefit or other thing of value of any officer, trustee, agent or employee of the Brownsville Public Utilities Board in return for the person having exercised their person's official discretion, power or duty with respect to this bid: the bidder certifies and represents that it has not now and will not in the future offer, confer, or agree to confer a pecuniary benefit or other thing of value to any officer, trustee, agent, or employee of the Brownsville Public Utilities Board in connection with information regarding this bid, the submission of this bid, the award of this bid or the performance, delivery or sale pursuant to this bid.

THE VENDOR/CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD HARMLESS THE CITY OF BROWNSVILLE AND THE BROWNSVILLE PUBLIC UTILITIES BOARD, ALL OF THEIR OFFICERS, AGENTS AND EMPLOYEES FROM AND AGAINST ALL CLAIMS, ACTIONS, SUITS, DEMANDS, PROCEEDINGS, COSTS, DAMAGES, AND LIABILITIES, ARISING OUT OF, CONNECTED WITH, OR RESULTING FROM ANY NEGLIGENT ACTS OR OMISSIONS OF CONTRACTOR OR ANY AGENT, EMPLOYEE, SUBCONTRACTOR, OR SUPPLIER OF CONTRACTOR IN THE EXECUTION OR PERFORMANCE OF THIS BID.

I have read all of the specifications and general bid requirements and do hereby certify that all items submitted meet specifications.

COMPANY:		
AGENT NAME:		
AGENT SIGNATURE:		
ADDRESS:		
CITY:		
STATE:	ZIP CODE:	
TELEPHONE:	TELEFAX:	
FEDERAL ID#:	_AND/OR SOCIAL SECURITY #:	
DEVIATIONS FROM SPECIFIC	ATIONS IF ANY:	
NOTE: QUESTIONS AND CON	CERNS FROM PROSPECTIVE CONTRACTORS SHOULD	Bl

NOTE: QUESTIONS AND CONCERNS FROM PROSPECTIVE CONTRACTORS SHOULD BE RAISED WITH OWNER AND ITS CONSULTANT (IF APPLICABLE) AND RESOLVED IF POSSIBLE, <u>PRIOR TO</u> THE BID SUBMITTAL DATE. ANY LISTED DEVIATIONS IN A FINALLY SUBMITTED BID MAY ALLOW THE OWNER TO REJECT A BID AS NON-RESPONSIVE.

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS (Complete and Return with Bid)

Name of Entity:

The prospective participant certifies to the best of their knowledge and belief that they and their principals:

- a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency:
- b) Have not within a three (3) year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, Local) with commission of any of the offenses enumerated in paragraph (b) of this certification; and
- d) Have not within a three (3) year period preceding this bid had one or more public transactions (Federal, State, Local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this bid or termination of the award. In addition, under 18 USC Section 1001, a false statement may result in a fine up to a \$10,000.00 or imprisonment for up to five (5) years, or both.

Name and Title of Authorized Representative (Typed)

Signature of Authorized Representative

Date

 \Box I am unable to certify to the above statements. My explanation is attached.

EPA FORM 5700-49 (11-88)

THIS FORM MUST BE COMPLETED IN ITS ENTIRETY & SUBMITTED WITH BID RESPONSE

CONFLICT OF INTEREST QUESTIONNAIRE For vendor doing business with local governmental entity	FORM CIQ		
This guestionnaire reflects changes made to the law by H.B. 23. 84th Leg., Regular Session.	OFFICE USE ONLY		
This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).	Date Received		
By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. <i>See</i> Section 176.006(a-1), Local Government Code.			
A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.			
1 Name of vendor who has a business relationship with local governmental entity.			
2 Check this box if you are filing an update to a previously filed questionnaire. (The law re completed questionnaire with the appropriate filing authority not later than the 7th busines you became aware that the originally filed questionnaire was incomplete or inaccurate.)	equires that you file an updated ss day after the date on which		
3 Name of local government officer about whom the information is being disclosed.			
Name of Officer			
4 Describe each employment or other business relationship with the local government offi officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with Complete subparts A and B for each employment or business relationship described. Attac CIQ as necessary.	icer, or a family member of the th the local government officer. The additional pages to this Form		
A. Is the local government officer or a family member of the officer receiving or l other than investment income, from the vendor?	ikely to receive taxable income,		
Yes No			
B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?			
Yes No			
5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.			
6 Check this box if the vendor has given the local government officer or a family member as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.00	of the officer one or more gifts 003(a-1).		
7			
Signature of vendor doing business with the governmental entity	Date		
Form provided by Texas Ethics Commission www.ethics.state.tx.us	Revised 1/1/2021		

CONFLICT OF INTEREST QUESTIONNAIRE For vendor doing business with local governmental entity A complete copy of Chapter 176 of the Local Government Code may be found at http://www.statutes.legis.state.tx.us/ Docs/LG/htm/LG.176.htm. For easy reference, below are some of the sections cited on this form. Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on: (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity: (B) a transaction conducted at a price and subject to terms available to the public; or (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency. Local Government Code § 176.003(a)(2)(A) and (B): (a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if: (2) the vendor: (A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds \$2,500 during the 12-month period preceding the date that the officer becomes aware that (i) a contract between the local governmental entity and vendor has been executed; or (ii) the local governmental entity is considering entering into a contract with the vendor: (B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than \$100 in the 12-month period preceding the date the officer becomes aware that: (i) a contract between the local governmental entity and vendor has been executed; or (ii) the local governmental entity is considering entering into a contract with the vendor. Local Government Code § 176.006(a) and (a-1) (a) Avendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and: (1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A); (2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or (3) has a family relationship with a local government officer of that local governmental entity. (a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of: (1) the date that the vendor: (A) begins discussions or negotiations to enter into a contract with the local governmental entity; or (B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or (2) the date the vendor becomes aware: (A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a); (B) that the vendor has given one or more gifts described by Subsection (a); or (C) of a family relationship with a local government officer.

Form provided by Texas Ethics Commission

www.ethics.state.tx.us

Revised 1/1/2021

BROWNSVILLE PUBLIC UTILITIES BOARD RESIDENCE CERTIFICATION

In accordance with Chapter 2252 of the Texas Government Code, the following will apply. The pertinent portion of the Code has been extracted and is as follows:

Section 2252.001

(3) "Nonresident bidder" refers to a person who is not a resident of Texas.

(4) "Resident bidder "refers to a person whose principal place of business is in this State, including a contractor whose ultimate parent company or majority owner has its place of business in this State.

Section 2252.002

A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident bidder underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in:

(1) The state in which the nonresident's principal place of business is located; or

(2) A state in which the nonresident is a resident manufacturer.

I certify that	(Company Name)
is a resident Texas bidder as defined in Sect	ion 2252.001(4) of the Texas Government Code.
Signature:	
Print Name:	
I certify that	(Company Name)
is a nonresident bidder as defined in Section our principal place of	2252.001(3) of the Texas Government Code and
business is:	
(City and State)	
Signature:	
Print Name:	

Previous Customer Reference Worksheet

Name of Customer:	Customer Contac	t:
Customer Address:	Customer Phone	Number:
	Customer Email:	
Name of Company Performing Referenced Work:		

What was the Period of Performance?	What was the Final Acceptance Date?
From:	
To:	
Dollar Value of Contract?	What Type of Contract?
	Firm Fixed Price
\$	Time and Material
	Not to Exceed
	Cost Plus Fixed Fee
	Other, Specify:

le a brief description of the work performed for this customer (add additional page if required)

NOTICE OF AWARD

TO: _____

Project Description: Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43

Dear Sir/Madam:

The Owner, BPUB has considered the BID submitted by you for the above-described Work in response to its Legal Notice and Invitation to Bid dated October 6, 2022 and Instruction to Bidders.

You are hereby notified that after any Owner adjustments to the Base Bid Amount to account for Owner options regarding additive and deductive alternates, your BID has been accepted in the final Contract Price amount of \$_____.

You are required by the Instructions to Bidders to execute the Construction Agreement and furnish any required Contractor's Performance Bond, Payment Bond and Certificates of Insurance within ten (10) calendar days from the date you receive this Notice.

In addition with the Bonds and Insurance Certificates, you must complete, execute, and submit a Contractor Job Safety Analysis (JSA) form. The JSA form is required prior to entering into a contractual agreement with the OWNER, and will be valid for a period of thirty (30) calendar days after which you must complete, execute and submit an updated JSA form. The completed JSA form is included as a part of the Contract Documents.

If you fail to execute this Agreement and furnish any required Bonds, Insurance Certificates, or other certifications within ten (10) calendar days from the date of this Notice, Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your BID as abandoned, and as a forfeiture of your BID BOND.

The Owner will be entitled to such other rights as may be granted by law and equity.

You are required to promptly sign and return an acknowledged copy of this NOTICE OF AWARD to the Owner.

Dated this _____ day of ______, 20__.

BROWNSVILLE PUBLIC UTILITIES BOARD OF THE CITY OF BROWNSVILLE, TEXAS

ACCEPTANCE OF NOTICE OF AWARD

Receipt of the above NOTICE OF AWARD is hereby acknowledged by:

	this day
of, 20	
By:	
Name:	
Title:	

NOTICE TO PROCEED

TO:

ADDRESS:

Contract for: Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43

You are notified that the Contract Time under the above Contract will commence to run on , 20 . By that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement, the date of Substantial Completion prior to final payment is ______, 20__.

Before you may start any Work at the site, Bonds and Insurance Certificates along with certain material submittals must be submitted and approved by the BPUB before a BPUB Purchase Order is issued and prior to the purchase and shipment of Work materials.

> Brownsville Public Utilities Board: (Owner)

BY: ______(Authorized Signature)

DATE:

NAME: John S. Bruciak, P.E.

TITLE: General Manager/CEO

FOR: Brownsville Public Utilities Board

CONSTRUCTION AGREEMENT

THIS AGREEMENT is by and between the BROWNSVILLE PUBLIC UTILITIES BOARD of the City of Brownsville, Texas (hereinafter called OWNER or BPUB) and <CONTRACTOR NAME> of <CITY & STATE> (hereinafter called CONTRACTOR), performing as an independent contractor.

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

Article 1. WORK.

CONTRACTOR shall furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the Work described herein and complete all the Work as specified or indicated in the Contract Documents. The Work is generally described as: Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43 (hereinafter referred to as "Work" and/or "Project").

Article 2. ENGINEER.

The Project has been designed by OWNER'S independent professional engineering consultant(s): CP&Y (hereinafter called ENGINEER).

Article 3. CONTRACT TIME.

3.1 The Work shall be <u>Substantially Completed</u> in accordance with paragraph 14.8 of the General Conditions within 545 consecutive Calendar Days after the date when the Contract Time commences to run as provided in paragraph 2.3 of the General Conditions, and <u>finally completed</u> and ready for final payment in accordance with paragraph 14.13 of the General Conditions within thirty (30) consecutive Calendar Days after the date of Substantial Completion as established in accordance with paragraph 14.8 of the General Conditions.

CONTRACTOR hereby acknowledges and agrees that the ENGINEER has already included in the calculation of the performance Calendar Days, normal, monthly, <u>non-compensable</u> rain days for Cameron County, Texas, based upon historical monthly National Oceanic and Atmospheric Administration (NOAA) record averages.

3.2 Liquidated Damages. OWNER and CONTRACTOR recognize that the TIME OF PERFORMANCE IS OF THE ESSENCE in this Agreement and that OWNER will suffer financial loss if the Work is not Substantially Complete within the time specified in Article 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. Both Parties hereto also recognize the delays, expense and difficulties involved in proving in a legal proceeding the actual loss suffered by OWNER if the Work is not Substantially Complete on time. Accordingly, instead of requiring such proof, OWNER and CONTRACTOR agree that as liquidated damages for the delay (but not as a penalty) CONTRACTOR shall pay OWNER FIVE HUNDRED DOLLARS AND NO CENTS (\$500.00) for each Calendar Day

that expires after the time specified in Article 3.1 for Substantial Completion, until the Work is Substantially Complete.

Article 4. CONTRACT PRICE.

4.1 CONTRACTOR shall perform the Work described in the Contract Documents for the Contract Price amount of <WRITTEN CONTRACT PRICE> (\$______), and OWNER shall pay CONTRACTOR in current funds based on the Bid Schedule.

Article 5. PAYMENT PROCEDURES.

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

5.1 **Progress Payments.** OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's mathematically correct Applications for Payment on or about the twentieth-fifth (25th) Calendar Day after submittal of the Application for Payment each month as provided below. All progress payments shall be on the basis of the progress of the Work measured by the Schedule of Values provided for in paragraph 14.1 of the General Conditions.

5.1.2. Prior to Substantial Completion, progress payments shall be in an amount equal to ninety-five percent (95%) of the amount requested in the Application for Payment, with five percent (5%) remaining as OWNER's retainage for the Project, to be released by OWNER in accordance with Article 5.2 below.

5.1.3. Upon Substantial Completion, OWNER shall pay an amount sufficient to increase total payments to CONTRACTOR to ninety-five percent (95%) of the Contract Price, less such amounts OWNER shall determine in accordance with paragraphs 14.7 and 14.8 of the General Conditions.

5.2 **Final Payment**. Upon final completion and acceptance of the Work after resolution of any punch list items in accordance with paragraph 14.8 and 14.13 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by Engineer as provided in said paragraphs 14.13.

Article 6. CONTRACTOR'S REPRESENTATIONS.

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

6.1 CONTRACTOR has familiarized himself with the Project, nature and extent of the Contract Documents, Work, and with all local conditions and federal, state and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the Work.

6.2 CONTRACTOR has made, or caused to be made, examinations and investigations of information as he deems necessary for the performance of the Work at the Contract Price, as determined by the Bid Schedule and finalized Schedule of Values as determined by Article 2 of the General Conditions, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations or similar data are, or will be required by CONTRACTOR for such purposes.

6.3 CONTRACTOR has given OWNER advanced written notice of all obvious conflicts, errors or discrepancies that he has discovered in the Contract Documents <u>prior to</u> <u>bidding</u>, and the written resolution thereof by OWNER was acceptable to CONTRACTOR.

6.4 CONTRACTOR is skilled and experienced to responsibly perform the type of Work described in the Contract Documents in a workmanlike and timely manner.

Article 7. CONTRACT DOCUMENTS.

The Contract Documents which comprise the entire Agreement between OWNER and CONTRACTOR are attached to this Construction Agreement, made a part hereof, and consist of the following:

- 7.1 Legal Notice and Invitation to Bid
- 7.2 Instructions to Bidders
- 7.3 Bid Forms and Bid Schedule
- 7.4 Bid Bond
- 7.5 Contractor's and Subcontractor's Pre-Bid Disclosure Statements
- 7.6 Notice of Award and Acceptance of Notice
- 7.7 Notice to Proceed
- 7.8 This Construction Agreement
- 7.9 Performance Bond
- 7.10 Payment Bond
- 7.11 General Conditions
- 7.12 Supplementary General Conditions
- 7.13 Technical Specifications
- 7.14 Addendum number(s) (page).
- 7.15 CONTRACTOR's Certificate(s) of Insurance.

Construction Drawings bearing the following general title: #B057-22 Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43 (Sheets 1 through 52)

7.16 Any Written Amendment, including Change Orders, duly delivered after execution of this Agreement.

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be altered, amended or repealed by a Written Amendment (as defined in Article 1 of the General Conditions).

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Article 8. MISCELLANEOUS.

Brownsville Public Utilities Board Construction Agreement #270413v2; 002/114 8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions shall have the meanings indicated in the General Conditions.

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

8.3 OWNER and CONTRACTOR each binds himself, his partners, successors, assigns and legal representatives to the other Party hereto, his partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

8.4 The invalidity or unenforceability of any provision of the Contract Documents shall not affect the validity or enforceability of any other provision of the Contract Documents.

8.5 This Construction Agreement and the Contract Documents are subject to all applicable local, Texas, federal laws, statutes, codes, ordinances, rules and regulations.

8.6 In the event of default by CONTRACTOR under the Contract Documents, OWNER shall have all rights and remedies afforded to it at law or in equity to enforce the terms of the Contract Documents. The exercise of any one right or remedy shall be without prejudice to the enforcement of any other right or remedy allowed at law or in equity.

8.7 If any action at law or in equity is necessary by OWNER to enforce or interpret the terms of the Contract Documents, OWNER shall be entitled to reasonable attorneys' fees, court costs, expert witness fees, and any necessary and reasonable supporting disbursements, in addition to any other relief to which the OWNER is entitled.

8.8 The Contract Documents constitute the ENTIRE AGREEMENT BETWEEN THE PARTIES hereto and supersede any prior written or oral agreements and understandings between the Parties. The Contract can only be modified or amended by written agreement of the Parties.

8.9 These Contract Documents are governed by the laws of the State of Texas and the Parties agree that venue for any litigation/arbitration/mediation arising from these Contract Documents shall lie in Cameron County, Texas.

Article 9. OTHER REQUIREMENTS

- 9.1 Workers' Compensation Insurance (For additional detail see: General Conditions paragraphs 5.3.1 and 5.5.1-2
 - A. By signing this Agreement, CONTRACTOR certifies that it provides workers' compensation insurance coverage for all employees employed on this Project pursuant to Tex. Lab. Code Sections 401 and 406.096(a).
 - B. As required by Section 406.096(b) of same Code, CONTRACTOR must require each Subcontractor to certify in writing to the CONTRACTOR that the Subcontractor provides workers' compensation insurance coverage for all of the employees it employs on this Project. CONTRACTOR must provide these certifications to the OWNER within ten (10) calendar days of the Effective Date of this Agreement.
- 9.2 Prohibition of Contracts with Companies Engaged in Business with Iran, Sudan, or Foreign Terrorist Organizations
 - A. See: Tex. Gov't Code Section 2252.152, Subchapter F, which prohibits the award of governmental contracts to companies engaged in business with Iran, Sudan, or foreign terrorist organizations.
 - B. By signing this Agreement, CONTRACTOR certifies that it is not ineligible to be awarded this Contract under said Chapter 2252, Subchapter F.
- 9.3 Prohibition of Contracts with Certain Companies that Boycott Israel
 - A. See: Tex. Gov't Code Chapter 2271 which prohibits the award of governmental contracts to companies boycotting Israel.
 - B. By signing this Agreement, CONTRACTOR certifies that it does not boycott Israel and will not boycott Israel during the term of this Contract.
- 9.4 Certificate of Interested Parties: CONTRACTOR must complete and submit a Certificate of Interested Parties (Form 1295) to the OWNER with the signed Agreement as required by Tex. Gov't Code Section 2252.908(e).

(THE REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK)

IN WITNESS WHEREOF, the Parties hereto have signed this Construction Agreement in <u>triplicate originals</u>. One counterpart each has been delivered to OWNER and CONTRACTOR, and the third will be filed with the ENGINEER.

This Construction Agreement will be Effective on ______, 20__, the date when OWNER signs below.

[NOTE: THE DATE OF THE PAYMENT AND PERFORMANCE BONDS CANNOT PRECEDE THIS EFFECTIVE CONTRACT DATE.]

BROWNSVILLE PUBLIC UTILITIES BOARD	<contractor></contractor>
By:	By:
Name: John S. Bruciak	Name:
Title: General Manager/CEO	Title:
Signature Date:	Signature Date:
Attest:	Attest:
Address for giving notices:	Address for giving notices:
Attn: David Ramirez, P.E.	Attn:
1425 Robinhood Drive	
Brownsville, TX 78521	
(956) 983-6348	
daramirez@brownsville-pub.com	

CONTRACTOR hereby acknowledges and understands that this is a "separated contract" pursuant to 34 Texas Administrative Code 3.291. The following amount of money represents that part of the total Contract Price representative of the value of tangible personal property to be physically incorporated into the Project realty: \$_____.

[NOTE: SEE GENERAL CONDITIONS PARAGRAPH 6.16, "Taxes", and "STATE SALES AND USE TAX EXEMPTION."]

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

THAT				
(Name of Contractor as Principal)				
	(Address of C	Contractor)		
a				
	(corporation, partners	hip, or individual)		
hereinafter	called	Principal,	and	
	(Name of	Surety)		
	(Address of	f Surety)		
hereinafter called Su	rety, are held and firmly boun	d unto the PUBLIC UTILITIES	BOARD of the	
City of Brownsvill	e, Texas, hereinafter called	OWNER as Obligee, in the	penal sum of	

Dollars (\$_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain Contract with the OWNER, dated the _____ day of ______, 20____, a copy of which is hereto attached and made a part hereof, for the construction of the Project: Packet 1-Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43.

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said Contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the one (1) year post-construction workmanship guaranty and minimum materials/equipment warranty period, and if he shall satisfy all claims and demands incurred under such Contract, and SHALL FULLY INDEMNIFY AND SAVE HARMLESS THE OWNER FROM ALL COSTS AND DAMAGES WHICH IT MAY SUFFER BY REASON OF FAILURE TO DO SO, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received, hereby stipulates and agrees: that no written change, extension of time, alteration or addition to the terms of the Contract or to Project Work to be performed thereunder, or the Specifications accompanying the same, shall in any ways affect its obligation on this PERFORMANCE BOND, and it does hereby waive notice

of any such written change, extension of time, alteration or addition to the terms of the Contract, or to the Project Work, or to the Specifications.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose timely filed and legally perfected claim may be unsatisfied.

This PERFORMANCE BOND is subject to and governed by Sections 2253.01-079 of the Texas Government Code (Vernon's Texas Codes Annotated) and Chapter 3503 of the Texas Insurance Code (VTCA), and all amendments thereto.

IN WITNESS WHEREOF, this instrument is <u>executed in triplicate originals</u>, each counterpart of which shall be deemed an original, this the _____ day of ______, 20___.

A. ATTEST:			
	(Principal)		
	By:	(s)	
(Principal) Secretary	(Signature of legally authorized Principal) Print Name	d representative of	
	Print Title		
(SEAL)			
(Witness as to Principal)	(Address)		
(Address)			
B. ATTEST:	(Surety)		
	(Survey)		
(Surety) Secretary	By: (Signature of Attorney-in-Fact for Surety)		
(SEAL)	Print Name		
(Witness as to Surety)	(Address)		
(Address)			
Brownsville Public Utilities Board Performance Bond #270413v2: 002/114	60	Bid No. 057-22	

NOTE: Date of PERFORMANCE BOND must not be prior to Effective Date (execution date by OWNER) of Contract. If CONTRACTOR is a Partnership, all partners should execute PERFORMANCE BOND.

IMPORTANT: Surety companies executing PERFORMANCE BONDS must be legally authorized by the Texas State Board of Insurance to transact business in the State of Texas, and be currently listed as an approved federal surety in the most recently issued edition (prior to Contract's Effective Date) of the U. S. Treasury Circular 570.

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

THAT

(Name of Contractor as Principal)

(Address of Contractor)

a

(corporation, partnership, or individual)

hereinafter called Principal, and

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto the PUBLIC UTILITIES BOARD of the City of Brownsville, Texas, hereinafter called OWNER as Obligee, the penal sum of Dollars (\$_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain Contract with the OWNER, dated the _____ day of ______, 20____, a copy of which is hereto attached and made a part hereof, for the construction of the: Packet 1- Wastewater Pumping Station Upgrades Lift Stations 9, 10, 11, and 43.

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, SUBCONTRACTORS, and corporations furnishing materials for, or performing labor in the prosecution of the WORK provided for in such Contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such WORK, and all insurance premiums on said WORK, and for all labor, performed in such WORK, whether by SUBCONTRACTORS or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to WORK to be performed thereunder, or the SPECIFICATIONS accompanying the same, shall in any wise affect its obligation 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, or to the Specifications.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge any remaining, timely and legally perfected right of any lawful beneficiary hereunder, whose timely filed and legally perfected claim may be unsatisfied.

This Bond is subject to and governed Sections 2253.01 of the Texas Government Code (Vernon's Texas Codes Annotated) and Chapter 3503 of the Texas Insurance Code (VTCA), and all amendments thereto.

IN WITNESS WHEREOF, this instrument is executed in triplicate, each counterpart of which shall be deemed an original, this the _____ day of _____, 20__.

ATTEST:

	(Principal)	
	By:	(s)
(Principal) Secretary	(Signatur	re)
(SEAL)		
(Witness as to Principal)	(Address	3)
(Address)		
ATTEST:		
	(Surety)	
	By:	
(Surety) Secretary	(Attorne	y-in-Fact)
(SEAL)		
(Witness as to Surety)	(Address	3)
(Address)		

NOTE: Date of PAYMENT BOND must not be prior to Effective Date (execution date by OWNER) of Contract. If Contractor is a Partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing PAYMENT BONDS must be legally authorized by the Texas Board of Insurance to transact business in the State of Texas, and be currently listed as an approved federal surety in the most recently issued edition (prior to Contract's Effective Date) of the U. S. Treasury Circular 570.
ATTACH POWER OF ATTORNEY

INSERT CERTIFICATE OF INSURANCE

GENERAL CONDITIONS

OF THE

CONSTRUCTION CONTRACT

Prepared by The Public Utilities Board of the City of Brownsville, Texas, as a periodically reviewed and revised Adaptation From the 1983 Base Document Prepared by

Engineers' Joint Contract Documents Committee

and originally

Issued and Published Jointly By:

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE A practice division of the NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN CONSULTING ENGINEERS COUNCIL

AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSTRUCTION SPECIFICATION INSTITUTE

The base document from which this adaptation (Spring 2020 BPUB) was prepared (1983 edition) was approved and endorsed by:

The Associated General Contractors of America

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GENERAL CONDITIONS

SCOPE. The Standard General Conditions of the Construction Contract prepared by the National Society of Professional Engineers (NSPE-1910-8, 1983 Edition) as periodically amended and adapted by the OWNER to meet local requirements, shall form a part of this Contract, together with the following Supplementary General Conditions. A copy of the locally amended Standard General Conditions (based upon NSPE-1910-8) is bound herewith. The following supplements modify, change, delete, or add to the General Conditions. Where any part of the General Conditions is modified or voided by any Supplementary General Conditions, the unaltered provisions of that part shall remain in effect.

ARTICLE 1. DEFINITIONS

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

Addenda - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents. These Addenda are a part of the Contract Documents and modify the Drawings, Specifications or other bid documents as indicated. No verbal changes in the Work not depicted or described in writing shall be binding.

Supplements to, changes in, or corrections to the Drawings and/or Specifications issued in writing by OWNER during the period of bidding. These Addenda are a part of the Contract and modify the Drawings and/or Specifications as indicated. No verbal changes in the Work as shown or described shall become binding.

Agreement - The written and signed short-form Construction Agreement (Contract or Agreement) between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents including these General Conditions are attached to the Construction Agreement and made a part thereof as provided therein.

Alternates. Additions to; deletions from; or changes to requirements for the Project, each of which shall be bid separately and shall be included in or deleted/deducted from the Contract at the discretion of OWNER.

Application for Payment - The form developed by OWNER which is to be used by CONTRACTOR in requesting interim progress or final Contract payments and which is to include such supporting documentation as is required by the Contract Documents.

Bid - The written offer or proposal of the bidder submitted on the OWNER prescribed form setting forth in figures and in script, the prices for the Work to be performed.

Bonds - Bid, Performance and Payment Bonds procured by the CONTRACTOR from a surety authorized by the Texas Department of Insurance to conduct business in the State of Texas, and any other instruments of security as may be specified by the OWNER.

Calendar Day –A calendar day consists of twenty-four hours and is measured from midnight, to the next midnight, and shall constitute a single calendar day. Calendar days include Saturdays and Sundays. THIS IS A CALENDAR DAY CONTRACT.

Change Order - A document developed by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision to the Work, or an adjustment in the Contract Price and/or the Contract Time, issued after the Effective Date of the Construction Agreement. Executed Change Orders are part of the amended Contract Documents.

Contract Documents – The Legal Notice and Invitation to Bid; Instructions to Bidder(s); Pre-Bid Disclosure Statements; Notice of Award; Notice to Proceed; The Construction Agreement; Addenda (which pertain to the Contract Documents); CONTRACTOR's Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award); the Bid, Performance and Payment Bonds; these General Conditions; the Supplementary Conditions; the Specifications and the Drawings; and those documents enumerated in Article 7 of the Construction Agreement; and those outlined in paragraphs 3.4 and 3.5 of the General Conditions.

Contract Price - The moneys payable by OWNER to CONTRACTOR under the Contract Documents as stated in the Agreement (subject to the General Conditions provisions of paragraphs 9.1 and 11.9.1 in the case of Unit Price Work).

Contract Time - The number of days ("calendar" days computed as provided in General Conditions paragraph 17.2) or the date specifically stated in the Agreement for the Substantial Completion of the Work.

CONTRACTOR - The person, firm or corporation with whom OWNER has entered into the Agreement to construct the Work.

Defective - An adjective which when modifying the word "Work" refers to "Work" that is unsatisfactory, faulty or deficient, or does not conform to, or comply with the Contract Documents, or does not meet the requirements of any inspection, referenced standard, test or approval referred to in the Contract Documents, or has been damaged prior to the time OWNER makes the final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with General Conditions paragraph 14.8 or 14.10).

Drawings - The drawings (plans) which depict the character, design, and scope of the Work to be performed and which have been prepared and/or approved by ENGINEER and are referred to in the Contract Documents.

Effective Date of the Agreement - The date indicated in the short-form Construction Agreement document upon which it becomes legally binding and effective, but if no such date is indicated, it means the date on which the Construction Agreement is signed by OWNER.

Engineer- The private, outside, independent professional engineering consulting firm(s) named as such in the Agreement.

Field Order - A written order issued by ENGINEER which orders <u>minor</u> changes or contains interpretations in the Work in accordance with General Conditions paragraph 9.5, but which does <u>not</u> involve a change in the Contract Price or the Contract Time.

Furnish. To supply at the Work jobsite the materials, supplies, equipment, etc., referred to in the Specifications and/or Drawings. Installation is not always required of the Supplier by the Specifications, but shall be performed or arranged for by the General CONTRACTOR.

General Requirements – Division 1 of the Specifications.

Laws and/or Regulations - Federal and/or State Laws, rules, administrative agency regulations, local ordinances, local codes and/or court orders applicable to the Work performance.

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

Notice to Proceed - A written notice given by OWNER to CONTRACTOR (with copy to ENGINEER) fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

OWNER'S Project Team (OPT) - The OWNER, OWNER'S Field Representative, ENGINEER, ENGINEER's Resident Project Representative, and the other entities identified in the Supplementary Conditions and the consultants, subconsultants, individuals or entities directly or indirectly employed or retained by them to provide services to the Owner.

OWNER - The City of Brownsville, acting through its Public Utilities Board (BPUB) of the City of Brownsville, Texas and its directly employed authorized representatives.

Partial Utilization - Placing a portion of the Work in service for the benefit of the OWNER and for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

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

Provide – To furnish and install the materials, supplies, equipment, etc. referred to in the Specifications and/or Drawings, at the location shown or otherwise approved at the Project Work job-site.

Site Observers - Resident Project Representative - The authorized representative of ENGINEER who is assigned to periodically observe the Work at the site of the Project, or any part

thereof, on behalf of OWNER. OWNER'S Field Representative – the authorized representative of OWNER who observes the daily Work progress on behalf of OWNER. These two Representatives will coordinate with each other.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by, or for CONTRACTOR, to illustrate some portion of the Work, and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by CONTRACTOR to ENGINEER, to illustrate material or equipment for some portion of the Work.

Special Conditions – Those portions of the Contract Documents unique to this Project and often mandated by third-party regulatory and funding authorities.

Specifications - Those portions of the Contract Documents consisting of written technical descriptions for the design configuration and/or performance standard for materials, equipment, any specified construction systems, standards and workmanship, as applied to the Work and certain administrative details applicable thereto.

Standard Abbreviations. Wherever reference is made to standard specifications, standards of quality or performance, as established by a recognized national authority, the reference may be by initials and acronyms as generally recognized throughout the engineering and construction industries.

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

Substantial Completion - The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by its ENGINEER's definitive written and signed certificate of Substantial Completion, and that it is apparently sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the OWNER's purposes for which it is intended; or if there is no such certificate issued by ENGINEER, when final payment is due in accordance with General Conditions paragraph 14.13. The terms "Substantially Complete" and "Substantially Complete" as applied to any Work refer to the Substantial Completion thereof.

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

Supplier - A manufacturer, fabricator, supplier, distributor, materialman or third-party vendor.

Underground Facilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such manmade facilities or attachments, and any outer encasements containing such facilities (vaults, conduits) which have been installed underground to furnish/transport any of the following services or materials: electricity, gases, steam, liquid

petroleum products, telephone or other related data communications, cable television, sewage, storm drainage, traffic or other electronic control systems or potable water.

Unit Price Work - Work to be paid for on the basis of unit prices for ENGINEER/OWNER estimated quantities.

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

Work Directive Change - A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in General Conditions paragraph 4.2 or 4.3 or to emergencies under General Conditions paragraph 6.24. A Work Directive Change may not change the Contract Price or the Contract Time, but is evidence that the parties expect that the change directed or documented by a Work Directive Change will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in General Conditions paragraph 10.2.

Working Day. When and if applicable, a week day (Monday through Friday only, inclusive) in which weather conditions are such that Work can be performed in a normal manner. Weekends (Saturday, Sunday) and OWNER holidays shall not be considered working days.

Written Amendment - A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the non-engineering or non-technical (rather the commercial terms, legal provisions, etc.), rather than Work-related, aspects of the Contract Documents. Written Amendments are normally embodied in a Change Order once construction commences.

ARTICLE 2. PRELIMINARY MATTERS

Delivery of Bonds:

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

Copies of Documents:

2.2 OWNER shall furnish to CONTRACTOR up to ten (10) copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished to CONTRACTOR, upon request, at the cost of reproduction reimbursable to OWNER.

Commencement of Contract Time; Notice to Proceed:

2.3 The Contract Time will commence to run and be accounted for on the date indicated in the Notice to Proceed. A Notice to Proceed may be given by OWNER at any time after the Effective Date of the Agreement. The CONTRACTOR should be prepared to perform Work as soon as Contract Time commences.

Starting the Project:

2.4 CONTRACTOR is obligated to perform the Work on the date when the Contract Time commences to run, but no Work shall be done at the Project site prior to the date on which the Contract Time commences to run per the Notice to Proceed.

Before Starting Construction:

2.5 Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby. CONTRACTOR shall be in **DEFAULT** to OWNER for failure to report to ENGINEER any obvious conflict, error, or discrepancy in the Contract Documents, if CONTRACTOR had actual knowledge thereof, or should reasonably have known thereof pursuant to customary construction industry standards.

2.6 Within ten (10) calendar days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1 an estimated Work Progress Schedule indicating the starting and completion dates of the various critical stages of the Work; and

2.6.2 a preliminary Schedule of Shop Drawing submissions; and

2.6.3 a preliminary Schedule of Values for all of the Work, which will include quantities and prices of items aggregating the total Contract Price and will subdivide the Work into logical component parts in sufficient detail to later serve as the basis for measuring actual Project progress and substantiating monthly payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work which will be automatically confirmed in writing by CONTRACTOR at the time of submission to ENGINEER.

2.7 By the tenth (10th) calendar day after award of the Contract by OWNER, CONTRACTOR shall deliver to OWNER (with copy to ENGINEER) original certificates (and any other evidence of insurance requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with Article 5.

Preconstruction Conference:

2.8 After the Effective Date of the Agreement, but before CONTRACTOR starts the Work at the Project site, a mandatory conference attended by CONTRACTOR, ENGINEER, OWNER and others as appropriate, will be held to discuss the Schedules referred to in paragraph 2.6, to discuss procedures for managing exchanges of Shop Drawings and other submittals and for processing Applications for Payment; and to establish a working and pragmatic understanding among the Project participants as to the general progress and administration of the Work.

Finalizing Schedules:

2.9 At least ten (10) calendar days before submission of the first monthly Application for Payment, a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to finalize the various Schedules submitted in accordance with Article 2.6. The finalized Progress Schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within the Contract Time, but such acceptance will neither impose on ENGINEER responsibility for the progress or scheduling of the Work, nor relieve CONTRACTOR from full responsibility therefore. CONTRACTOR acknowledges the ENGINEER has already included in the calculation of the performance calendar days agreed to by CONTRACTOR by its Bid submission in this calendar day Contract, normal non-compensable monthly rain days for Cameron County, Texas. The CONTRACTOR shall update this Progress Schedule no less than monthly at each payment submittal. The CONTRACTOR shall only include in the submittal any abnormal and unusual rain days that exceed those typically experienced in Cameron County, Texas, based upon historical monthly National Oceanic and Atmospheric Administration (NOAA) record averages (rain days will be verified by the ENGINEER and the Site Observers weekly), and any OWNER approved time extensions in the modified Progress Schedule. The amended monthly Work Progress Schedule shall be reviewed and accepted by the ENGINEER and the OWNER monthly as a pre-condition to payment to CONTRACTOR. The finalized Schedule of Shop Drawing submissions will be acceptable to ENGINEER as providing a workable arrangement for processing the exchange of submissions. The finalized Schedule of Values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

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

3.2 It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents as being required of CONTRACTOR to produce the OWNER'S intended result will be supplied by CONTRACTOR, whether or not specifically called for. When words which have a well-known

technical or trade meaning are used to describe Work, materials or equipment, such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, whether such reference is specific or by implication, shall mean the latest amended standard specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Construction Agreement, if there were no Bids for a specialty project), except as may be otherwise specifically stated. However, no provision of any reference in the Contract Documents) shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR, ENGINEER or any of their consultants, agents or employees from those set forth in the Contract Documents , nor shall it be effective to assign to ENGINEER, or any of ENGINEER's subconsultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of paragraphs 9.15 or 9.16. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER in writing as provided in paragraph 9.4.

3.3 If, during the performance of the Work, CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, CONTRACTOR shall immediately report same to ENGINEER in writing, and before proceeding with the Work affected thereby, shall obtain a written interpretation or clarification from ENGINEER. CONTRACTOR shall be in **DEFAULT** to OWNER for failure to report any obvious conflict, error or discrepancy in the Contract Documents if CONTRACTOR had actual knowledge thereof, or should reasonably have known thereof, pursuant to customary construction industry standards.

Amending and Supplementing Contract Documents:

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

- 3.4.1 a formal Written Amendment,
- 3.4.2 a Change Order (pursuant to definition and paragraph 10.4), or
- 3.4.3 a Work Directive Change (pursuant to definition and paragraph 10.1).

As indicated in paragraphs 11.2 and 12.1, Contract Price and Contract Time may only be changed by a Change Order or a Written Amendment.

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

3.5.1 a Field Order (pursuant to definition and paragraph 9.5),

3.5.2 OWNER Engineer's approval of a Shop Drawing or sample (pursuant to

definition and paragraphs 6.25 through 6.30), or

3.5.3 OWNER Engineer's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.6 Neither CONTRACTOR, Subcontractor nor any (including sub-tier subcontractors) or Supplier, or other related person or organization performing or furnishing any of the Project Work to OWNER, shall have or acquire any title to, or ownership rights in, any of the Drawings, Specifications or other Contract Documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER, and they shall not reuse any of them on extensions of the Project or any other project without written consent of OWNER and ENGINEER, and specific written verification or adaptation by ENGINEER for a fee. All Drawings, Specifications or other Documents (or copies of any thereof) are upon completion of the Project to become the property of OWNER. Further use thereof without written consent of OWNER and ENGINEER is prohibited and solely at the risk of the user.

ARTICLE 4. AVAILABILITY OF LANDS: PHYSICAL CONDITIONS: REFERENCE POINTS

Availability of Lands:

4.1 OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way, licenses and easements for access thereto and such other lands which are specifically designated by OWNER for the use of CONTRACTOR. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR believes that any delay in OWNER's furnishing of these lands, rights-of-way, licenses or easements entitles CONTRACTOR to an extension of the Contract Time, CONTRACTOR may make a claim therefore as provided in Article 12. CONTRACTOR may privately and separately provide at his own option and non-reimbursable cost, for any and all additional lands, and access thereto, that may be required for CONTRACTOR'S temporary construction facilities or storage of materials and equipment.

4.2 **Physical Condition:**

4.2.1 Explorations and Reports: Reference is made to the Supplementary Conditions for any identification of any reports of geotechnical explorations and tests of subsurface conditions at the Project site that may have been utilized by ENGINEER in preparation of the Contract Documents. Any of these geotechnical explorations and reports are expressly not part of these Contract Documents. CONTRACTOR may not rely upon the accuracy of the technical data contained in any such reports, nor upon non-technical data, interpretations or opinions contained therein or for the completeness thereof, for CONTRACTOR's purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to CONTRACTOR'S advanced, pre-bid exploration, testing and

determining any CONTRACTOR risk and cost associated with encountering any subsurface conditions at the Project site.

4.2.2 **Existing Structures:** Reference is made to the Supplementary Conditions for any identification of those Drawings of physical conditions in or relating to existing surface or subsurface structures (except Underground Facilities referred to in paragraph 4.3) which are at or contiguous to the Project site that have been utilized by ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data actually contained in such drawings, <u>but not for the current physical conditions or description completeness thereof for CONTRACTOR's purposes</u>. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to current locating, verification, investigation of, and encountering physical conditions in or relating to such structures.

4.2.3. **Report of Differing Conditions:** If CONTRACTOR believes that:

4.2.3.1 any technical data on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is inaccurate, or

4.2.3.2 any physical condition uncovered or revealed at the Project site differs materially from that indicated, reflected or referred to in the Contract Documents,

CONTRACTOR shall, promptly after becoming aware thereof and <u>before performing any</u> <u>Work in connection therewith</u> (except in an emergency as permitted by paragraph 6.22), <u>notify</u> <u>OWNER's Field Representative and ENGINEER's Resident Project Representative in writing</u> <u>about the inaccuracy or difference</u>.

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

4.2.5 **Possible Document Change:** If ENGINEER concludes that there is a material error in the Contract Documents, or that because of newly discovered, latent physical conditions, a change in the Contract Documents is required, a Work Directive Change or a Change Order may be issued as provided in Article 10 to reflect and document the consequences of the inaccuracy or difference.

4.2.6 **Possible Price and Time Adjustments:** In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, may be allowable to the extent that they are attributable to any such inaccuracy or difference. If OWNER and CONTRACTOR are unable to agree as to the financial impact or length thereof, a CONTRACTOR or OWNER claim may be made therefore as provided in Articles 11 and 12. All increases or decreases in the Contract Price shall be governed by all State and local statutes, codes, laws, ordinances, rules and regulations governing public competitive bidding and Change Orders.

Physical Conditions

4.3 Underground Facilities:

4.3.1 **Shown or Indicated:** The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Project site is only based on existing available information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities, (Non-OWNER utilities, pipeline companies, railroads, etc.) or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1 OWNER and ENGINEER shall not be responsible for the actual current conditions, accuracy or completeness of any such third-party information or data; and,

4.3.1.2 <u>CONTRACTOR</u> shall have full responsibility before commencement of related Work for reviewing and checking all such current information and data; for locating all actual current Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction; for the safety and protection thereof as provided in paragraph 6.20 and; paying for the repair of any damage thereto resulting from the Work; the cost of all of which is mutually considered between OWNER and CONTRACTOR as having been included in the CONTRACTOR'S original Contract Price.

4.3.2 Not Shown or Indicated: If an Underground Facility is uncovered or revealed at or contiguous to the Project site which was not shown or indicated in the Contract Documents, and which CONTRACTOR could not reasonably have been expected to be aware of under customary construction industry standards, CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency as permitted by paragraph 6.22), identify the owner of such Underground Facility and give written notice thereof to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document any consequences of the existence of the Underground Facility, and the Contract Documents may be amended or supplemented to the extent necessary. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR may be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents, and which CONTRACTOR could not reasonably have been expected to be aware of pursuant to customary construction industry standards. If the parties are unable to agree as to the financial impact or length thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12. All increases or decreases in the Contract Price shall be governed by all State and local statutes, codes, laws, ordinances, rules and regulations governing public competitive bidding and Change Orders.

Reference Points:

4.4. CONTRACTOR shall be responsible for laying out the Work (unless otherwise specified by OWNER in the General Requirements), and shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of ENGINEER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and CONTRACTOR shall be responsible for the accurate replacement or relocation of such reference points by CONTRACTOR-retained professionally qualified personnel (not including OWNER or ENGINEER representatives).

ARTICLE 5. BONDS AND INSURANCE

Performance and Payment Bonds:

For a Contract in excess of \$100,000.00, a Performance Bond shall be procured and executed by CONTRACTOR in the full amount of the Contract Price conditioned upon the faithful performance of the Work for OWNER in accordance with the Plans, Specifications and Contract Documents. Said Bond shall be solely for the protection of the OWNER.

For a Contract in excess of \$50,000.00, a Payment Bond shall be executed in the full amount of the Contract Price, for the primary protection of all claimants against the surety for non-payment in supplying labor, materials and equipment in the prosecution of the Work provided for in the Contract, for the use of each such claimant timely perfecting a proper claim against surety.

5.1 CONTRACTOR shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance of the Work for OWNER and payment of all CONTRACTOR's labor, materials, equipment and supply obligations under the Contract Documents. **These Bonds shall remain in effect by CONTRACTOR at least until one year after the date when final payment becomes due,** except as otherwise provided by Law or Regulation or by the Contract Documents. CONTRACTOR shall also furnish any such other bonds as may be required by the Supplementary Conditions (e.g. any maintenance, extended warranty, special indemnity, etc.). All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and be executed by such sureties as are authorized to do business in the State of Texas. All Bonds signed by an agent ("attorney in fact") must be accompanied by a certified copy of the authority to act on behalf of the surety.

5.2 If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent, or its right to do business in Texas is terminated or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within five (5) calendar days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

Contractor's Liability Insurance:

5.3 CONTRACTOR shall purchase and maintain such commercial general liability and other insurance coverages as are appropriate for the Work being performed and furnished, and as

will provide protection from claims set forth below which may arise out of, or result from, CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents; whether it is to be performed or furnished by CONTRACTOR, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work; or by anyone for whose acts and/or omissions any of them may be liable:

5.3.1 Claims under workers' compensation, disability benefits and other similar employee benefit acts. <u>This is a Texas public works Contract and any CONTRACTOR'S or Subcontractor's attempted rejection of the worker's compensation act, and thereby substituting a CONTRACTOR'S or Subcontractor's self-insurance reserve, is specifically prohibited by Texas law.</u>

5.3.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees traditionally covered by employer's liability insurance;

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

5.3.4 Claims for damages insured by personal injury liability coverage which are sustained: (a) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR; or (b) by any other person for any other reason;

5.3.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, <u>including loss of use resulting therefrom;</u>

5.3.6 Claims arising out of operation of Laws or Regulations for damages because of bodily injury or death of any person or for damage to property; and

5.3.7 Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any owned or hired motor vehicle.

The various insurance coverages required by this Article 5 shall include the specific type coverage and be underwritten for <u>not less than</u> the limits of liability and coverage amounts provided herein below or in the Supplementary Conditions, or required by law, whichever is <u>greater</u>. The commercial general liability insurance shall include completed operations insurance. All of the policies of insurance so required to be purchased and maintained (or the certificates or other evidence thereof) shall be of an "occurrence"-type, when applicable, and shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least (<u>30</u>) thirty days prior written notice has been given to OWNER by certified mail. All such insurance shall remain in effect until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing defective Work in accordance with paragraph 13.12. In addition, CONTRACTOR shall maintain such <u>completed operations</u> insurance for at least two (2) years after final payment and furnish OWNER with evidence of

continuation of such insurance at final payment and one year thereafter. <u>Insurance coverage</u> furnished under the Contract Documents (except for Workmen's Compensation and any professional engineering errors and omissions liability insurance that CONTRACTOR or his agent might carry applicable to this Project) shall include the City of Brownsville and BPUB as OWNER, and their respective City Commissioners, public officials, officers, Board Members, and employees, as named additional insureds and hereinafter known as "additional insureds."

The following entities are to also be specifically named as additional insureds:

- City of Brownsville, Texas Attn: City Secretary Griselda Rosas City Plaza, First Floor 1034 E. Levee St. Brownsville, Texas 78520
- Brownsville Public Utilities Board 1425 Robinhood Drive Brownsville, TX 78521

Contractual Liability Insurance:

5.4 The commercial general liability insurance required by paragraph 5.3 will include contractual liability insurance applicable to CONTRACTOR's <u>INDEMNITY</u> obligations under paragraphs 6.32 and 6.33.

5.5 <u>Specific Coverages of Insurance Required by Owner:</u>

5.5.1 <u>Workmen's Compensation and Employer's Liability</u>. This insurance shall protect the laborer, and insure the CONTRACTOR, and insulate the additional insureds, against all claims under applicable Texas workmen's compensation laws, pursuant to subparagraph 5.3.1. The additional insureds shall also be protected under an <u>Employer's Liability policy</u> against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workmen's compensation law. This Employer's Liability policy shall include an "all states" endorsement.

5.5.2. Mandatory TWCC Rule 28 TAC Sect. 110.110 Adapted Language

(A) **Definitions:**

Certificate of coverage ("certificate") - A copy of a certificate of insurance, or a coverage agreement, showing statutory workers' compensation insurance coverage for the person's or entity's (CONTRACTOR's) employees providing services on this public works Project, for the duration of this Project.

"Duration of the Project" - includes the time from the beginning of the Work on this Project until the CONTRACTOR's/person's Work on this Project has been completed and accepted by the OWNER.

"Persons providing services on the Project" ("subcontractor" in § 406.096) includes all persons or entities performing all or part of the services the CONTRACTOR has undertaken to perform on this 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 this Project.

"Services" - include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to this Project.

- (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, § 401.011(44) for all employees of the CONTRACTOR providing services on this Project, for the duration of this Project.
- (C) The CONTRACTOR must provide a certificate of coverage to the OWNER 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 this Project, the CONTRACTOR must, prior to the end of the coverage period, file a new certificate of coverage with the OWNER showing that coverage has been extended.
- (E) The CONTRACTOR shall obtain from each person providing services on this Project, and provide to the OWNER:
 - (1) a certificate of coverage, prior to that person beginning Work on this Project, so the OWNER will have on file certificates of coverage showing coverage for all persons providing services on this Project; and
 - (2) no later than seven (7) calendar 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 this Project.
- (F) The CONTRACTOR shall retain all required certificates of coverage for the duration of this Project and for three (3) years thereafter.
- (G) The CONTRACTOR shall notify the OWNER in writing by certified mail or personal delivery, within ten (10) calendar 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 this Project.

- (H) The CONTRACTOR shall post on this Project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on this 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 this Project, to:
 - (1) 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, § 401.011(44) for all of its employees providing services on this Project, for the duration of this Project;
 - (2) provide to the CONTRACTOR, prior to that person beginning Work on this Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on this Project, for the duration of this Project;
 - (3) 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 this Project;
 - (4) obtain from each other person with whom it contracts, and provide to the CONTRACTOR:
 - (a) a certificate of coverage, prior to the other person beginning Work on this Project; and
 - (b) 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 this Project;
 - (5) retain all required certificates of coverage on file for the duration of this Project and for three (3) years thereafter;
 - (6) notify the OWNER in writing by certified mail or personal delivery, within ten (10) calendar 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 this Project; and
 - (7) contractually require each person with whom it contracts, to perform as

required by clauses (I)-(1-7) of this subparagraph, 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 OWNER that all employees of the CONTRACTOR who will provide services on this Project will be covered by workers' compensation coverage for the duration of this 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. 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 OWNER to declare the Contract void if the CONTRACTOR does not remedy the breach within ten (10) calendar days after receipt of notice of breach from the OWNER.

The liability limits shall not be less than:

Workmen's compensation	Texas Statutory Limits
Employer's liability	\$100,000.00 each occurrence

5.5.3 <u>Comprehensive Business Automobile Liability</u>. This insurance shall be written in comprehensive business form and shall protect the CONTRACTOR and the additional insureds against all claims described under Section 5.3.7. of the General Conditions of the Contract Documents and arising from the use of motor vehicles, and shall cover, on or off the Project site, all motor vehicles licensed for highway use, whether they are owned, non-owned, or hired.

The liability limits <u>shall not be less than</u>:

Bodily Injury and	\$500,000.00 combined single
property damage	limit each occurrence

5.5.4 <u>Commercial General Liability</u>. This insurance shall be an "occurrence" type policy written in commercial form and shall protect the CONTRACTOR and the additional insureds against all claims described in Sections 5.3, 5.3.3., 5.3.4., 5.3.5., 5.3.6, 5.4 of the General Conditions of the Contract Documents arising out of any intentional or negligent act and/or omission of the CONTRACTOR or his agents, employees, or subcontractors. This policy shall also include protection against claims insured by usual personal injury liability coverage.

The liability limits shall not be less than:

Personal Injury and	\$1,000,000.00 combined single
property damage	limit each occurrence and

and \$1,000,000.00 aggregate

If the CONTRACTOR'S Work, or Work under his direction, requires blasting, explosive conditions, or underground operations, the commercial general liability coverage shall contain no exclusion relative to blasting, exploding, collapse of structures, or damage to underground property.

5.5.5 <u>Excess Umbrella Liability Policy</u>. This insurance shall protect the CONTRACTOR and the additional insureds against all claims in excess of the limits provided under the employer's liability, comprehensive business automobile liability, and commercial general liability policies. The liability limits of the umbrella policy <u>shall not be less than</u> \$2,000,000.00. The policy shall be an "occurrence" type policy.

5.5.6 <u>Transportation Insurance</u>. This insurance shall be of the "all risks" type and shall protect the CONTRACTOR and the OWNER from all insurable risks of physical loss or damage to equipment and materials in transit to the Project jobsite and until the OWNER receives the equipment and materials at the Project jobsite. The coverage amount <u>shall be not less than one-half</u> of the full amount of the total Contract Price.

Transportation insurance shall provide for losses to be payable to the CONTRACTOR and the OWNER as their respective legal interests may appear.

5.5.7 All policies required under paragraph 5.5 herein shall contain a "cross liability" or "severability of interest" clause or endorsement. Notwithstanding any other provision of these policies, the insurance afforded shall apply separately to each insured, named insured, or additional insured with respect to any claim, suit, or judgment made or brought by or for any other insured, named insured, or additional insured, as though a separate policy had been issued to each, except the insurer's liability shall not be increased beyond the amount or amounts for which the insurer would have been liable had only one insured been named.

5.5.8 CONTRACTOR shall require each of his Subcontractors to procure and maintain during the life of his subcontract, Subcontractor's Commercial General Liability and Property Damage Insurance of the type specified in subparagraphs 5.5.1, 5.5.2, 5.5.3, 5.5.4 and paragraph 5.6 hereof, in the same amounts as required by OWNER for CONTRACROR, unless alternative amounts are approved in writing by OWNER.

5.5.9 The insurance required under subparagraphs 5.5.1, 5.5.2, 5.5.3, 5.5.4 and paragraph 5.6 hereof shall provide adequate protection for CONTRACTOR and his Subcontractors respectively against damage claims which may arise from operations under this Contract, whether such operation is by the insured or by anyone directly or indirectly employed by him, and also, against any special hazards which may be encountered in the performance of this Contract.

5.5.10 <u>CONTRACTOR shall not commence any Work under this Contract</u> until he has obtained all the insurance coverage required under this Article 5. and such insurance has been approved by OWNER; nor shall CONTRACTOR allow any Subcontractor to commence Work on this Contract until the insurance required by the Subcontractor has been so obtained and

approved.

Property Insurance:

5.6 Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain property insurance upon the Work at the Project site to the full insurable value thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions, established by current customary construction industry standards given the type of Work in Cameron County, Texas and value thereof, or as may be required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, and Subcontractors, in the Work, all of whom shall be listed as insured or additional insured parties, which shall insure against the perils of fire and extended coverage and shall include "all risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in the Supplementary Conditions (e.g. flood, wind, etc.); and shall include damages, losses and expenses arising out of or resulting from any insured loss or cost incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all risk" insurance or otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this paragraph shall be of an "occurrence"-type, when applicable, and contain a provision that the coverage afforded will not be canceled or materially changed until at least (30) thirty calendar days prior written notice has been given to OWNER by certified mail.

5.6.1 Property Insurance Coverage. This insurance shall protect CONTRACTOR and the additional insureds against all claims described in Section 5.6 and shall provide the following minimum amounts:

Property Insurance Coverage: Provide Full Contract Price Amount or \$100,000.00 Minimum, whichever is greater.

Waiver of Rights:

5.7 Waiver

5.7.1 CONTRACTOR waives all rights against OWNER, (unless OWNER or other named entities as additional insureds were solely negligent), for all losses and damages caused by any of the perils covered by the policies of insurance provided in response to paragraph 5.6 and any other property insurance applicable to the Work, and also waives all such rights against all other entities named as additional insureds in such policies for losses and damages so caused. As required by paragraph 6.12, each subcontract between CONTRACTOR and a Subcontractor will contain similar "flow down" waiver provisions by the Subcontractor in favor of CONTRACTOR, OWNER, ENGINEER and their respective sub-consultants, and all other entities named as additional insureds.

5.7.2 CONTRACTOR intends that any policies provided in response to paragraph 5.6 shall protect all of the entities insured and provide primary coverage for all losses and damages caused by the perils covered thereby. Accordingly, all such policies shall contain provisions to the effect that in the event of payment of any loss or damage, the insurer will have no rights of recovery against any of the entities named as insured or additional insured, and if the insurers require separate waiver forms to be signed by any Subcontractor, CONTRACTOR will obtain the same.

Acceptance of Insurance:

5.8 If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.3, 5.4, 5.5 and 5.6 on the basis of the coverages not complying with the Contract Documents, OWNER will attempt to notify CONTRACTOR in writing thereof within ten (10) calendar days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.7. CONTRACTOR shall provide to the OWNER such additional information regarding the insurance provided by CONTRACTOR as the OWNER may reasonably request. Failure on the part of the OWNER or its agents to detect an insurance deficiency as compared to the insurance requirements of the Contract shall not constitute a waiver by the OWNER of the insurance requirements which CONTRACTOR and/or Subcontractor must contractually meet to be in compliance herewith.

Partial Utilization - Property Insurance:

5.9 If OWNER finds it necessary to occupy, use, or operate a portion or portions of the Work prior to Substantial Completion of all the Work, such use, occupancy or operation may be accomplished in accordance with paragraph 14.10. CONTRACTOR shall have the obligation to inform the insurers of OWNER's intent to so occupy, use or operate a portion or portions of the Work. The <u>insurers</u> of CONTRACTOR providing the property insurance <u>shall consent</u> to such use, occupancy or operation by <u>endorsement</u> on the policy or policies, but the property insurance shall not be canceled or lapse on account of any such partial use, occupancy, or operation by OWNER.

ARTICLE 6. CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1 CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents and customary construction industry standards. <u>CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, procedures, safety and quality control of construction, but CONTRACTOR shall not be responsible for any negligence of others in any design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. <u>CONTRACTOR shall be solely responsible to guarantee that the</u></u>

finished Work complies accurately with the Contract Documents and CONTRACTOR shall not rely upon the OWNER's and/or ENGINEER'S construction observation to accomplish same.

6.2 CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER, except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given directly to CONTRACTOR.

Labor, Materials and Equipment:

6.3 CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work, oversee quality control, monitor safety, and perform construction of the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the Project site. Except in connection with the safety or protection of persons or the Work or property at the Project site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the Project site shall be performed during regular daily working hours (generally eight (8) hours between 7:00 A. M. and 6:00 P.M.) as may be specifically set forth by the OWNER, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's advanced written consent. Preference employment shall be given to resident citizens of the Cameron County, Texas area where such persons are available and fully qualified to perform the Work to which the employment relates.

6.3.1 CONTRACTOR shall acquaint himself with all matters and conditions concerning the Project site and any existing construction. Any practical and constructive criticism or exception regarding any feature of the Work must be presented in writing to OWNER at least ten (10) calendar days prior to bidding. After the Contract Agreement to perform the Work has been signed by CONTRACTOR, it shall then be his responsibility to provide satisfactory Work that will meet the full intent of the Contract Documents. CONTRACTOR shall then pursue this Work with the other trades so that all phases of the Work may be properly coordinated without delays or damage to any parts of the Work.

6.4 Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.4.1 CONTRACTOR shall provide and maintain suitable weather-tight, washable, sanitary toilet facilities for all workmen for the entire construction period. CONTRACTOR shall comply with all requirements of applicable health authorities. When toilet facilities are no longer required, promptly remove them from the Project site, disinfect and clean the surface area as required. CONTRACTOR shall keep each toilet facility swept and supplied with toilet tissue at all times.

6.5 All materials and equipment shall be of good quality and <u>new, except as otherwise</u> <u>specifically provided in the Contract Documents</u>. Sometimes a project specification may require salvage and reinstallation of OWNER's recently acquired machinery and equipment pre-existing at a project site. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment procured for the Project. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier, except as otherwise provided in the Contract Documents; but no provision of any such Supplier instructions will be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16.

6.6 CONTRACTOR shall notify OWNER and ENGINEER in writing of any conflict between the manufacturer's directions and the Contract Documents and <u>shall not perform any</u> <u>Work on any item until such conflict has been resolved</u>. Upon award of the Contract, CONTRACTOR will secure a certificate of exemption from the Texas State Comptroller to preserve the OWNER's exemption from Limited Sales, Excise and Use Tax in an amount representing that part of the total Contract Price representative of the value of tangible personal property to be physically incorporated into the Project realty. The certificate of exemption must contain a statement to the effect that such materials or property have been, or will be, utilized in the performance of the Contract to the full extent of the amount for which a certificate of exemption is requested.

6.6.1 Except where otherwise specified, CONTRACTOR shall, at all times, provide protection against weather, so as to maintain all Work, materials and fixtures free from injury or damages. All new Work likely to be damaged by weather shall be covered or otherwise protected as required.

6.6.2 While it is appreciated that CONTRACTOR has to maintain continuous construction operations and sequences, it should be understood that the OWNER's electric, gas, water, wastewater production and distribution systems must function during the Contract period with a minimum of inconvenience to the OWNER's customers and the OWNER. Requirements of the: Texas Commission on Environmental Quality (TCEQ); Texas Railroad Commission (TRC); Electric Reliability Council of Texas (ERCOT); and the State and federal regulatory agencies having jurisdiction over the Project site, must be met by CONTRACTOR. It is therefore incumbent on CONTRACTOR to plan ahead on the basis of integrating his construction sequencing program as far as possible into the normal operating sequence of the various utility systems to avoid or minimalize disruption of services. No departure from the normal operating sequence of the utility systems will be allowed, except with the specific advanced written agreement of OWNER.

6.6.3 CONTRACTOR shall notify OWNER and ENGINEER in writing a minimum of forty-eight (48) hours in advance of any Work which will be tied into the existing utility systems. Method of tie-in shall be submitted to ENGINEER for his approval prior to any Work being performed. At no time shall contaminated water that has not been disinfected be

allowed to seep into any existing waterlines, and at no time shall sewage be allowed to flow into surrounding Project areas. Connections will be made during times of daily minimum sewage flows, if required by Project.

6.6.4 CONTRACTOR shall coordinate his Work with that of other contractors whose work may occur at a conflicting time and location. The coordination shall be such that CONTRACTOR's Work will be maintained at a normal rate. Any priority of contractors' performance disputes will be decided by OWNER, after consultation with ENGINEER.

6.6.5 All Work that is performed on, across or along International Boundary and Water Control Commission levees must conform to all I.B. & W.C.C. requirements. All Work performed on, across or along Brownsville Irrigation and Drainage District or the Cameron County Water Control and Improvement District No.16 canals or ditches must conform to all District requirements.

6.6.6 Satisfactory access or detour roads shall be provided by CONTRACTOR where necessary due to his construction.

6.6.7 If required by the Bid or Project Specifications, or by law for the type of excavation construction being performed, CONTRACTOR and his Registered Professional Engineer shall develop the Trench Safety System Plan and shall provide any necessary shoring, bracing and/or sheeting pursuant to Section 756.023 of the Texas Health and Safety Code and OSHA 29 C.F.R. 1926, Subpart P, Vol. 54 No. 209 of the Federal Register, October 31, 1989, pp. 45959-45991, and, as provided in Section 11 - "Trench Excavation and Shoring Safety Plan" of the OWNER's Standard Specifications.

6.6.8 CONTRACTOR shall routinely provide adequate barricades and warning devices in conformance with the guidelines for Traffic Control as established by the Texas Department of Transportation (TDOT) in the Texas Manual on Uniform Traffic Control Devices (TMUTCD). This provision shall be incidental and subsidiary to the rest of the Work in this Contract, and shall not constitute a separate CONTRACTOR pay item.

6.6.9 CONTRACTOR shall provide to OWNER the services of technical representative(s) from Supplier(s) for CONTRACTOR furnished equipment, for a sufficient period of time to assist in start-up and initial adjustment of all installed or delivered equipment, and to train, advise and consult with OWNER's operating personnel, if appropriate for the Project.

6.6.9.1 For each mechanical system, CONTRACTOR shall provide to OWNER a written certification from the manufacturer's representative that the products of the manufacturer have been installed by CONTRACTOR in conformance with the manufacturer's requirements and recommendations.

6.6.10 All items of equipment required for this Contract shall be Bid to provide as part of the Contract Price, any literature explaining "Operation and Maintenance" (O&M) of that item of equipment. If a manufacturer does not print such a standard O&M manual, CONTRACTOR shall develop and provide OWNER with a customized manual approved in

writing by the manufacturer.

Adjusting Progress Schedule:

6.7 CONTRACTOR shall submit to ENGINEER for the Project record and acceptance only, <u>and not approval or concurrence</u> to the extent indicated in paragraph 2.9, periodic adjustments in the Progress Schedule to reflect the impact thereon of new Project developments; these revised Schedules will conform generally to the Progress Schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

Substitutes or "Or-Equal" Items:

6.8

6.8.1 As a general rule, the OWNER and ENGINEER prefer all determinations regarding proposed Substitutions of materials or equipment as potential "or-equal-items" be resolved during the pre-Bid phase. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item, or the name of a particular Supplier, the naming of the item is intended to establish the type, function, performance standard and quality required. In some instances, the OWNER, after consultation with ENGINEER, is legally allowed to "sole source" a specific material or component of equipment when its design and/or performance is required to integrate with a larger OWNER system that will remain in place, or that OWNER has an inventory of spare parts for, or that OWNER has a long favorable, performance reliability history with. Unless the material or equipment name is followed by words indicating that no substitution is permitted, materials or equipment of other Suppliers generally may be accepted by ENGINEER, if sufficient information is submitted by CONTRACTOR to allow ENGINEER to determine that the material or equipment proposed is equivalent, or equal to, that named by ENGINEER. The procedure for review by ENGINEER will include the following as supplemented in the General Requirements. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying in writing that the proposed substitute will adequately perform the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The CONTRACTOR'S written application will state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for any other work on the Project by other contractors) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any vendor license fee or royalty. All variations of the proposed substitute from that specified will be identified in the CONTRACTOR'S written application and available maintenance, repair and replacement parts and service will be indicated. The CONTRACTOR'S written application will also contain an itemized estimate of all costs or savings that will result directly or indirectly from acceptance of such substitute, including costs of redesign, operation, performance, and potential claims or protests of other contractors

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affected by any resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish at CONTRACTOR's non-compensable expense additional data about the proposed substitute.

6.8.2 If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, CONTRACTOR may generally furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to ENGINEER, if CONTRACTOR submits sufficient written information to allow ENGINEER to determine that the substitute proposed can be legally utilized by CONTRACTOR (e.g. patented or licensed processes) and is equivalent to that indicated or required by the Contract Documents. OWNER may have similar legal rights to "sole source" as generally indicated above in paragraph 6.8.1. The procedure for review by ENGINEER will be similar to that provided in paragraph 6.8.1 above, as applied by ENGINEER and as may be supplemented in the General Requirements.

6.8.3 ENGINEER will be allowed a reasonable time within which to evaluate each proposed substitute. <u>ENGINEER will be the sole judge of acceptability, and no substitute</u> will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's non-compensable expense, a special performance guaranty bond or other form of surety with respect to any accepted substitute. ENGINEER will record time required by ENGINEER and any ENGINEER's outside technical consultants in evaluating substitutions proposed by CONTRACTOR and in making any required changes in the Contract Documents occasioned thereby. <u>Whether or not</u> ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and any ENGINEER's consultants for evaluating each proposed substitute.

Concerning Subcontractors, Suppliers and Others:

6.9

6.9.1 CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.9.2 The Pre-Bid documents require the CONTRACTOR to identify Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of material and equipment), to be submitted to OWNER at the time of bidding. OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto) of any such Subcontractor, Supplier or other person or organization so identified by CONTRACTOR may be revoked by OWNER or ENGINEER on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute. The Contract Price may be increased by the difference in the cost occasioned by such substitution and an appropriate Change Order or written Amendment may be executed by the OWNER and

CONTRACTOR. All increases or decreases in the Contract Price shall be governed by all State and local statutes, codes, laws, ordinances, rules and regulations governing public competitive bidding and maximum Change Order limits. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject any defective or non-compliant Work.

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

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

6.12 All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate written agreement between CONTRACTOR and the Subcontractor, which specifically binds the Subcontractor through appropriate "flow down" provisions, to the applicable terms and conditions of the Contract Documents for the benefit of OWNER, and contains waiver provisions as required by paragraph 5.7.

Patent Fees and Royalties:

6.13 CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device, which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work, and if to the actual knowledge of OWNER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE CITY OF BROWNSVILLE AND THE BROWNSVILLE PUBLIC UTILITIES BOARD, INCLUDING THEIR RESPECTIVE COMMISSIONERS, BOARD MEMBERS **OFFICERS AND EMPLOYEES (INDEMNITEES) AGAINST ANY CLAIMS, DAMAGES,** LOSSES AND EXPENSES (INCLUDING ATTORNEYS' FEES AND COURT COSTS) **ARISING OUT OF ANY INFRINGEMENT OF PATENT RIGHTS OR COPYRIGHTS** INCIDENT TO THE USE IN THE PERFORMANCE OF THE WORK OR RESULTING FROM THE INCORPORATION IN THE WORK OF ANY INVENTION, DESIGN, PROCESS, PRODUCT OR DEVICE NOT SPECIFIED IN THE CONTRACT DOCUMENTS, AND SHALL DEFEND ALL SUCH CLAIMS IN CONNECTION WITH ANY ALLEGED INFRINGEMENT OF SUCH RIGHTS. IT IS THE EXPRESSED

INTENTION OF THE PARTIES HERETO THAT THE INDEMNITY PROVIDED FOR IN THIS PARAGRAPH IS INDEMNITY BY CONTRACTOR TO INDEMNIFY AND PROTECT INDEMNITEES FROM THE CONSEQUENCES OF OWNER'S OWN NEGLIGENCE WHERE THAT NEGLIGENCE ON THE PART OF THE OWNER IS A CONCURRING CAUSE OF THE CLAIMS, DAMAGES, LOSSES, AND EXPENSES REFERENCED ABOVE. FURTHERMORE, THE INDEMNITY PROVIDED FOR IN THIS PARAGRAPH <u>SHALL HAVE NO APPLICATION</u> TO ANY CLAIM, DAMAGE, LOSS AND EXPENSE REFERENCED ABOVE WHERE SUCH RESULTS FROM THE <u>SOLE NEGLIGENCE OF THE OWNER</u> INDEPENDENT OF THE FAULT OF ANY OTHER PERSON OR ENTITY.

Permits:

6.14 Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids. CONTRACTOR shall pay all charges of utility owners with the exception of those normally charged by OWNER, for connections to the Work, and OWNER shall pay all charges of such third-party utility owners for facility capital costs related thereto such as impact fees or plant investment fees, if any.

6.14.1 Fires shall not be built on the Project premises except by the express consent of OWNER and Brownsville City and/or County Fire Marshall.

Laws and Regulations:

6.15

6.15.1 CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, OWNER shall not be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.15.2 If CONTRACTOR has actual knowledge that the Specifications or Drawings are at variance with any Laws or Regulations, CONTRACTOR shall give ENGINEER prompt written notice thereof, and any necessary changes will be authorized by OWNER by one of the methods indicated in paragraph 3.4. <u>If CONTRACTOR performs any Work knowing, or having reason to know, that it is contrary to such Laws or Regulations, and without such advanced written notice to ENGINEER, CONTRACTOR shall bear all costs arising therefrom; however, it shall not be CONTRACTOR's original and primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and Regulations.</u>

Taxes:

6.16 "Pursuant to 34 Texas Administrative Code 3.291, in order for the OWNER to

continue to benefit from its status as a State Sales and Use Tax Exempt Organization, after August 14, 1991 public works construction contracts must be awarded on a "separated contract" basis. A "separated contract" is one where the CONTRACTOR distinguishes in writing prior to starting Work, between the value of the tangible personal property (materials such as pipe, bricks, lumber, concrete, paint, etc.) to be physically incorporated into the Project real estate from the total Contract price. Under the "separated contract" format, the CONTRACTOR in effect becomes a "seller" to the OWNER of materials that are to be physically incorporated into the Project real estate. As a "seller", the CONTRACTOR will issue a "Texas Certificate of Resale" to the CONTRACTOR'S supplier in lieu of paying the sales tax on the Project materials at the time of purchase. The CONTRACTOR will also issue a "Certificate of Exemption" to the supplier, demonstrating that the personal property is being purchased for resale and that the resale is to a public owner, the City of Brownsville, Texas, and its BPUB, which are sales tax exempt entities under UTCA Tax Code Section 151.309(5). CONTRACTOR should be careful to consult the most recent guidelines of the Texas State Comptroller of Public Accounts regarding the sales tax status of supplies and equipment that are used and consumed during Project Work (e.g. gas, oil, fluids, rental equipment, etc.), but that are not physically incorporated into the Project real estate. Such items are generally not tax exempt. If the CONTRACTOR has questions about the implementation of this policy he is asked to inquire with the State Comptroller of Public Accounts, Tax Administration Division, State of Texas, Austin, Texas 78774. The CONTRACTOR will not include any federal taxes in Bid prices since the OWNER is exempt from payment of such taxes. "Texas Certificates of Exemption", "Texas Certificates of Resale" and "Texas Sales Tax Permits" are forms available to the CONTRACTOR through the regional offices of the Texas State Comptroller of Public Accounts."

6.16.1. On the last page of the Construction Agreement a blank is provided for the CONTRACTOR to fill in an amount in dollars and cents indicating the Bid price of all materials and other tangible personal property included in the total Bid that will be physically incorporated into the Project real estate. The amount to be filled in by CONTRACTOR has reference to all of such materials and other tangible personal property as will actually be physically incorporated into the final result of the Work covered by the Contract. "Tangible personal property" means personal property which may be seen, weighed, measured, felt or touched, or which is in any other manner perceptible to the senses.

6.16.2. Upon award of the Contract, OWNER will, on written request of CONTRACTOR, furnish CONTRACTOR with a certificate of exemption from the Texas Limited Sales, Excise and Use Tax in only an amount not exceeding the above mentioned bid price for materials and other tangible personal property that will be physically incorporated into the Project real estate. Such written request by CONTRACTOR must contain a statement to the effect that such materials or property will be utilized in the performance of the Contract, to the full extent of the amount for which a certificate of exemption is requested. The Texas Comptroller of Public Accounts often audits contractors regarding compliance with these paragraph 6.16 provisions.

Use of Premises:

CONTRACTOR shall confine construction equipment, the storage of materials and 6.17 equipment and the operations of workers to the Project site and land and areas identified in and permitted by the Contract Documents, or otherwise privately acquired by the CONTRACTOR, and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements. CONTRACTOR shall assume full responsibility for any damage to any Project land or area, and to the owner or occupant of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against OWNER by any such adjacent owner or occupant because of the performance of the Work, CONTRACTOR shall promptly attempt to settle with such other party by agreement, or otherwise resolve the claim by mediation, arbitration or at law. CONTRACTOR SHALL INDEMNIFY, AND HOLD HARMLESS THE CITY OF **BROWNSVILLE AND THE** BPUB INCLUDING THEIR RESPECTIVE COMMISSIONERS, BOARD **MEMBERS OFFICER'S** AND **EMPLOYEES** (INDEMNITEES) FROM AND AGAINST ALL CLAIMS, DAMAGES, LOSSES AND EXPENSES (INCLUDING, BUT NOT LIMITED TO, FEES OF ENGINEERS, **ARCHITECTS, ATTORNEYS AND OTHER PROFESSIONALS AND COURT COSTS)** ARISING DIRECTLY, INDIRECTLY OR CONSEQUENTIALLY OUT OF ANY ACTION, LEGAL OR EQUITABLE, BROUGHT BY ANY SUCH OTHER THIRD PARTY ENTITY AGAINST OWNER, TO THE EXTENT BASED ON A CLAIM ARISING **OUT OF CONTRACTOR'S NEGLIGENT PERFORMANCE OF THE WORK. IT IS THE** EXPRESSED INTENT OF THE PARTIES HERETO THAT THE INDEMNITY PROVIDED FOR IN THIS PARAGRAPH IS INDEMNITY BY CONTRACTOR TO INDEMNIFY AND PROTECT THE INDEMNITEES FROM THE CONSEQUENCES OF THE INDEMNITEES' OWN NEGLIGENCE, WHEN THAT NEGLIGENCE ON THE PART OF THE INDEMNITEES IS A CONCURRING CAUSE OF THE INJURY, DEATH **OR DAMAGE.**

FURTHERMORE, THE INDEMNITY PROVIDED FOR IN THIS PARAGRAPH SHALL HAVE <u>NO APPLICATION</u> TO ANY CLAIM, LOSS, DAMAGE, CAUSE OF ACTION, SUIT, AND LIABILITY WHERE THE INJURY, DEATH OR DAMAGE RESULTS FROM THE <u>SOLE NEGLIGENCE</u> OF THE INDEMNITEES, INDEPENDENT OF THE FAULT OF ANY OTHER PERSON OR ENTITY.

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

6.19 CONTRACTOR shall be confined to all working real estate and easements provided by OWNER, unless CONTRACTOR separately and privately secures at his own non-reimbursable cost, additional private temporary construction easements. Generally, storage of excavation material and all CONTRACTOR equipment and material shall remain within the limits of Project and working easements.

6.20 CONTRACTOR shall not weight load or permit any part of any structure or utility to be loaded in any manner that will endanger the structure or utility, nor shall CONTRACTOR subject any part of the Work or adjacent property to surcharge stresses or pressures, or loss of subjacent or lateral support, that will endanger it.

Record Documents:

6.21 CONTRACTOR shall as a precondition to interim monthly progress payments, show evidence of regularly maintaining and updating and storing in a safe place at the Project site, one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Directive Changes, Field Orders and any written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and periodically annotated to show all changes made by <u>CONTRACTOR during construction</u>. These periodically updated record documents, together with all approved samples and a counterpart of all approved Shop Drawings, will be at all times available to ENGINEER for on-site reference. Upon completion of the Work, these record documents, samples and Shop Drawings, will be delivered to ENGINEER for OWNER record retention.

Safety and Protection:

6.22 <u>CONTRACTOR shall be solely responsible for</u> initiating, maintaining and supervising <u>all safety precautions</u> and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of employees and the general public, and shall also provide the necessary protection to prevent damage, injury or loss to:

6.22.1 other persons and organizations who may be required to properly visit the Project site;

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

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

6.22.4 Driveways, culverts, storm sewer inlets and laterals, and other public or private property that is destroyed or removed during the construction shall be replaced to its original or better condition by CONTRACTOR. <u>Temporary drainage and any subgrade</u> dewatering is to be provided by CONTRACTOR in the total Contract Price as necessary to protect and complete the Work.

6.22.5 <u>CONTRACTOR is responsible for locating any underground obstacles</u>. It is not represented by OWNER or ENGINEER that the Plans show all previous or current sewers, waterlines, electric lines, gas lines, telephone lines and other underground obstacles and utilities. CONTRACTOR shall exercise caution to prevent damage to existing utilities and other obstacles or facilities not meant for demolition or construction modifications during the progress of the

construction Work, <u>taking care to locate same in advance of the actual Work</u>. OWNER or ENGINEER will render reasonable assistance to CONTRACTOR in the matter of determining the location of existing utilities by making available such existing maps, records, and other available existing information as may be accessible to OWNER or ENGINEER, when requested to do so, <u>but the accuracy of such information will not be guaranteed by OWNER or ENGINEER</u>. CONTRACTOR shall make repairs and/or replacements to all damage to existing utilities resulting from his operations. Where a pipe, duct or other structure of a utility is exposed, which, in the opinion of ENGINEER requires strengthening, altering, shielding or moving, if that utility owner does not cure the situation itself, CONTRACTOR shall perform such Work on same as ENGINEER may order in writing after consultation by ENGINEER with the affected utility owner, that Work, if any, may be paid for by OWNER as extra Work. Should CONTRACTOR, in the layout of his Work, encounter any pipe, underground utility or structure, the location of <u>which has not been furnished to him by ENGINEER</u>, he shall bring such conditions to the attention of ENGINEER for ENGINEER, OWNER and CONTRACTOR discussion to determine the CONTRACTOR'S method to be used to pin in place, remove or bypass such obstructions.

6.22.6 It is essential that in the event of any CONTRACTOR damage being caused to existing utilities, that immediate attention be given to their repair. <u>Any repair work carried out shall be at the non-reimbursable cost of CONTRACTOR and shall be performed to the complete satisfaction of ENGINEER and OWNER, who will acknowledge same in writing</u>. It is therefore, the duty of CONTRACTOR, prior to Bid submittal if possible, and no later than the commencement of construction, to inspect and accurately record in writing to OWNER and ENGINEER, the pre-existing condition of any utility which he reasonably suspects or knows to be damaged, faulty, or defective. In addition, any such utilities so recorded, which in the opinion of CONTRACTOR may deteriorate further as a result of the proposed mode of construction operations should be protected. CONTRACTOR shall discuss with OWNER and ENGINEER what appropriate remedial measures should be employed by CONTRACTOR or utility owner to reach a resolution.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property, or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners, the scheduling and location(s), that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, restoration and replacement of their property. All damage, injury or loss to any property referred to in paragraphs 6.22.3 and 6.22.4 caused, directly or indirectly, in whole or in part by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work; or anyone for whose acts any of them may be liable; shall be remedied by CONTRACTOR. CONTRACTOR's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable to ENGINEER (except as otherwise expressly provided in connection with Substantial Completion).

6.23 CONTRACTOR shall designate in writing to OWNER a responsible representative

at the Project site whose duty shall be the management of risk and safety, and that person shall make a concerted effort to assist workers and visitors at the Project site to prevent accidents. This person shall be CONTRACTOR's superintendent, unless otherwise designated in writing by CONTRACTOR to OWNER.

Emergencies:

6.24 In emergencies affecting the safety or protection of persons, or the Work, or property at the Project site or adjacent thereto, CONTRACTOR, <u>without special written or oral instruction or authorization from ENGINEER or OWNER</u>, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Work or Contract Documents is recommended because of the CONTRACTOR's prompt action taken in response to an emergency, a Work Directive Change or Change Order may be issued by OWNER to document the consequences of any changes or variations.

Shop Drawings and Samples:

6.25 After checking and verifying all field measurements and after complying with applicable procedures specified in the General Requirements, CONTRACTOR shall submit to ENGINEER for review and approval, in accordance with the accepted Schedule of Shop Drawing submissions (see process in paragraphs 2.6 and 2.9), or for other appropriate action if so indicated in the Supplementary Conditions, a copy of all Shop Drawings, to ENGINEER, which will bear a stamp or specific written indication by ENGINEER that CONTRACTOR has satisfied CONTRACTOR's submission review responsibilities under the Contract Documents. All submissions will be identified as the ENGINEER may require. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable ENGINEER to efficiently and comprehensively review the CONTRACTOR's information as required.

6.25.1 Before ordering any material or doing any Work, CONTRACTOR will verify all measurements of any existing and new Work and shall be responsible for their correctness. Any differences which may be found shall be submitted to ENGINEER for consideration <u>before proceeding with the Work. No extra compensation will be allowed to CONTRACTOR because of differences between actual dimensions and measurements indicated on the Drawings.</u>

6.26 CONTRACTOR shall also submit to ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that CONTRACTOR has internally satisfied CONTRACTOR's submission review responsibilities under the Contract Documents and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which the material is intended.

6.27
6.27.1 Before submission of each Shop Drawing or sample, CONTRACTOR shall have internally determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each Shop Drawing or sample with other Shop Drawings and samples, and with the requirements of the Work and the Contract Documents.

6.27.2 At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents, and, in addition, shall cause a specific notation to be made on each Shop Drawing submitted to ENGINEER for review and approval, of each such CONTRACTOR variation.

6.28 ENGINEER will review and approve with reasonable promptness, Shop Drawings and samples, but ENGINEER's review and approval will be <u>only for general conformance with the design concept of the Project</u> and for compliance with the information given in the Contract Documents, and shall not extend to CONTRACTOR's means, methods, technique, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents), or to CONTRACTOR's safety precautions or programs incident thereto. The review and approval of a separate or component item will not indicate approval of the assembly into which the item integrally functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required, new samples for review and approval. CONTRACTOR shall direct ENGINEER's specific attention in writing to the <u>most current revisions</u>, other than the corrections called for by ENGINEER on previous CONTRACTOR submittals.

6.29 ENGINEER's review and approval of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents, unless CONTRACTOR has in writing called ENGINEER's specific attention to each such variation at the time of submission as required by paragraph 6.27.2, and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for CONTRACTOR's errors or omissions in the Shop Drawings, or from responsibility for having complied with the provisions of paragraph 6.27.1.

6.30 <u>Where a Shop Drawing or sample is required by the Specifications, any related</u> <u>Work performed prior to ENGINEER'S review and approval of the pertinent submission will be</u> <u>at the sole risk, and non-reimbursable expense and responsibility of CONTRACTOR</u>.

Continuing the Work:

6.31 CONTRACTOR shall carry on the Work and adhere to the Progress Schedule during any and all disputes or disagreements with OWNER. <u>No Work shall be delayed or postponed pending resolution of any disputes or disagreements</u>, except as OWNER may otherwise agree to in writing.

INDEMNIFICATION:

6.32 CONTRACTOR AGREES TO AND SHALL INDEMNIFY AND HOLD HARMLESS THE CITY OF BROWNSVILLE AND THE BROWNSVILLE PUBLIC UTILITIES BOARD, INCLUDING THEIR RESCPECTIVE COMMISSIONERS, BOARD **MEMBERS, OFFICERS, AND EMPLOYEES (INDEMNITEES) FROM AND AGAINST** ANY AND ALL CLAIMS, LOSSES, DAMAGES, CAUSES OF ACTION, SUITS, AND LIABILITY OF EVERY KIND, INCLUDING ALL EXPENSES OF LITIGATION, COURT COSTS, AND ATTORNEY'S FEES, FOR INJURY TO OR DEATH OF ANY PERSON, OR FOR DAMAGE TO ANY PROPERTY, ARISING OUT OR IN CONNECTION WITH THE NEGLIGENT PERFORMANCE OF THE WORK, **PROVIDED THAT SUCH CLAIM, DAMAGE, LOSS, LIABILITY OR EXPENSE: (A) IS** ATTRIBUTABLE TO BODILY INJURY, SICKNESS, DISEASE OR DEATH OR TO **INJURY OR DESTRUCTION OF TANGIBLE PROPERTY, INCLUDING THE LOSS OF** USE RESULTING THEREFROM; AND (B) IS CAUSED IN WHOLE OR IN PART BY ANY CONDITION OF THE WORK OR MATERIALS, OR BY ANY NEGLIGENT ACT OR OMISSION OF CONTRACTOR, ANY SUBTIER SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY CONTRACTOR OR ANY SUBCONTRACTOR OR ANYONE FOR WHOSE ACTS CONTRACTOR OR ANY SUBCONTRACTOR MAY BE LIABLE UNDER THIS CONTRACT.

SUCH INDEMNITY SHALL APPLY WHERE THE CLAIMS, LOSSES, DAMAGES, CAUSES OF ACTION, SUITS, OR LIABILITY ARISE IN PART FROM THE CONCURRENT NEGLIGENCE OF INDEMNITEES.

IT IS THE EXPRESSED INTENTION OF THE PARTIES HERETO, BOTH CONTRACTOR AND INDEMNITEES THAT THE INDEMNITY PROVIDED FOR IN THIS PARAGRAPH IS INDEMNITY BY THE CONTRACTOR, TO INDEMNIFY AND PROTECT INDEMNITEES FROM THE CONSEQUENCES OF INDEMNITEE'S OWN NEGLIGENCE, WHERE THAT NEGLIGENCE IS A CONCURRING CAUSE OF THE INJURY, DEATH OR DAMAGE. FURTHERMORE, HOWEVER, THE INDEMNITY PROVIDED FOR IN THIS PARAGRAPH SHALL HAVE <u>NO APPLICATION</u> TO ANY CLAIM, LOSS, DAMAGE, CAUSE OF ACTION, SUIT, AND LIABILITY WHERE THE INJURY OR DEATH OR DAMAGE RESULTS FROM THE SOLE NEGLIGENCE OF THE INDEMNITEES, INDEPENDENT OF THE FAULT OF ANY OTHER PERSON OR ENTITY.

6.33 IN ANY AND ALL CLAIMS AGAINST INDEMNITEES OR ANY OF THEIR CONSULTANTS, AGENTS OR EMPLOYEES BY ANY EMPLOYEE OF CONTRACTOR, ANY SUBCONTRACTOR, ANY PERSON OR ORGANIZATION DIRECTLY OR INDIRECTLY EMPLOYED BY ANY OF THEM TO PERFORM OR FURNISH ANY OF THE WORK, OR ANYONE FOR WHOSE ACTS ANY OF THEM MAY BE LIABLE, THE INDEMNIFICATION OBLIGATION UNDER PARAGRAPH 6.32 SHALL NOT BE LIMITED IN ANY WAY BY ANY LIMITATION ON THE AMOUNT OR TYPE OF DAMAGES, COMPENSATION OR BENEFITS PAYABLE BY

OR FOR CONTRACTOR, OR ANY SUCH SUBCONTRACTOR, OR OTHER PERSON OR ORGANIZATION UNDER WORKERS' OR WORKMEN'S COMPENSATION ACTS, DISABILITY BENEFIT ACTS OR OTHER EMPLOYEE BENEFIT ACTS.

6.34 THE OBLIGATIONS OF CONTRACTOR UNDER PARAGRAPH 6.32 SHALL NOT EXTEND TO ANY LIABILITY OF ENGINEER ARISING OUT OF THE PREPARATION OR APPROVAL OF PROJECT MAPS, DRAWINGS, DESIGNS, PLANS, SPECIFICATIONS, OPINIONS, CALCULATIONS, REPORTS, AND SURVEYS.,

6.35 CONTRACTOR shall perform all phases of Work, other than general clean-up, through the duration of the Contract, as defined in these General and any Supplementary Conditions. If CONTRACTOR desires to perform Work, other than general clean-up, during weekends or holidays, prior proper arrangements must be made in writing with OWNER, or any other regulatory agency regarding such Work.

6.35.1 <u>General</u>. This Contract shall be based upon payment by CONTRACTOR and his Subcontractors of wage rates <u>not less than</u> the General Prevailing Wage Rate of per diem wages for work of a similar character in Cameron County, Texas, for each type of laborer, workman or mechanic needed to implement the Contract at the Project Site, and <u>not less than</u> the general prevailing rate of per diem wages for legal holiday and overtime Work. The Schedule of General Prevailing Wage Rates specifically adopted by the OWNER for this Project, and other important Wage and Labor Standard Provisions are included in these Contract Documents in the Supplementary Conditions. Pursuant to local OWNER labor policy, <u>no Project worker shall be</u> <u>paid less than \$8.00 per hour</u>, regardless of the adopted wage listings in the attached U. S. Department of Labor General Wage Decision for Cameron County, Texas.

CONTRACTOR shall at minimum comply with all requirements of the prevailing wage law of the State of Texas, Texas Revised Civil Statutes, Texas Government Code (TGC) Section 2259.001 et seq., including the latest amendments thereto, and those special local wage provisions adopted by OWNER. When in conflict, the more stringent requirements apply to CONTRACTOR.

6.35.2 <u>Records</u>. CONTRACTOR and each Subcontractor shall keep an accurate record showing the names and occupations of all classifications of laborers, workmen, and mechanics employed, together with the actual wages paid to each worker. At all reasonable working hours, such CONTRACTOR records shall be open to inspection by the representatives of the OWNER. With each monthly application for payment, CONTRACTOR shall provide to ENGINEER a certified copy of such payroll records as necessary to substantiate compliance with this provision during the period of time for which the application for payment pertains. OWNER shall take cognizance of any and all employee complaints regarding any violations of the requirements of TGC Section 2259.001 et seq.

6.35.3 <u>Penalty</u>. In case CONTRACTOR and any Subcontractor fail to comply with the prevailing wage law, by statutory authority, CONTRACTOR shall forfeit to the OWNER \$60.00 per calendar day, or portion thereof, for each laborer, workman, or mechanic who is paid

less than the specified local rate for any Work done under the Contract.

6.35.4 <u>Hours of Labor</u>. CONTRACTOR shall comply with all requirements of the hours of work on public works in accordance with the laws of the State of Texas, Texas Revised Civil Statutes, Articles 5165.1 to 5165.3, including the latest amendments thereto.

No CONTRACTOR or Subcontractor contracting for any part of the Contract Work which may require or involve the employment of laborers, workmen or mechanics at the Project Site, shall require or permit any laborer, workman or mechanic in any work week in which he is employed on such Work, to work <u>in excess of forty (40) hours in such work week</u>, unless such laborer, workman or mechanic receives compensation at a rate not less than one and one-half times his basic rate of pay, for all hours in excess of forty (40) hours in such work week.

6.35.5 <u>Equal Employment Opportunities</u>. The CONTRACTOR shall not discriminate against any employee or applicant for employment because of race, religion, gender, sexual preference, national origin, age, physically challenged condition, or a political belief or affiliation, and will comply with all State and federal statutes applicable to CONTRACTOR which relate to employment discrimination.

6.35.6 <u>Veterans Preference</u>. Pursuant to Texas Revised Civil Statutes, Article 4413(31), including the latest amendments thereto, CONTRACTOR shall give preference in employment to honorably discharged veterans who were engaged in the military services of the United States in time of war or conflict and who are, and have been, citizens of Texas for not less than five (5) years.

ARTICLE 7. OTHER WORK

Related Work at Site:

7.1 OWNER may perform other separate work related to the Project at the site by OWNER's own forces, have other work performed by utility owners, or award other direct construction contracts therefor, which shall contain General Conditions similar to these. If the fact that such other work is to be performed was <u>not</u> originally noted in these Contract Documents, advance written notice thereof will be given to CONTRACTOR prior to OWNER authorizing any <u>such other work</u>; and, if CONTRACTOR believes that such other work performance will involve additional expense to CONTRACTOR, or requires additional time, and the Parties hereto are unable to agree as to the extent thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12. All increases or decreases in the Contract Price shall be governed by all State and local laws, statutes, codes, ordinances, rules and regulations governing public competitive bidding and Change Orders.

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

7.3 If any part of CONTRACTOR's Work depends upon the separate work of any such other contractor or utility owner (or OWNER) for proper execution or results, CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that renders it unavailable or unsuitable for such integration, proper execution and results of CONTRACTOR'S Work. <u>CONTRACTOR's failure to so report will constitute an acceptance of the other separate work</u> as fit and proper for integration with CONTRACTOR's Work, except for latent or non-apparent defects and deficiencies in the other work.

Coordination:

7.4 If OWNER contracts with others for the performance of other separate work on the Project at the Project site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified by OWNER in the Supplementary Conditions, or OWNER'S WORK DIRECTIVE CHANGE, and the specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided, in the Supplementary Conditions or OWNER'S WORK DIRECTIVE CHANGE.

ARTICLE 8. OWNER'S RESPONSIBILITIES

8.1 OWNER shall issue all written and oral communications to CONTRACTOR through OWNER's Field Representative and/or ENGINEER.

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

8.3 OWNER shall furnish the data required of OWNER under the Contract Documents promptly, and shall make eligible payments to CONTRACTOR within the time periods allowed by the Contract Documents and State prompt pay statutes, after payments are due as provided in Article 14.

8.4 OWNER's duties in respect to providing lands and easements and providing any recent existing available engineering surveys to establish CONTRACTOR construction reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of any existing and available reports of explorations

and tests of subsurface pre-existing conditions at the Project site <u>which are not part of the Contract</u> <u>Documents</u>, but which have been utilized by ENGINEER in generally preparing the Drawings and Specifications.

8.5 OWNER is obligated to consider and may execute Change Orders as indicated in paragraph 10.4.

8.6 OWNER's responsibility in respect to certain inspections, tests and approvals is set forth in paragraphs 13.3 through 13.5.

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

ARTICLE 9. ENGINEER'S STATUS DURING CONSTRUCTION

Owner's Representative:

9.1 OWNER's private consulting ENGINEER (generally through its Resident Project Representative) will be OWNER's primary representative during the construction period. OWNER's Field Representative will be the <u>secondary</u> representative during the construction period.

Visits to Site:

9.2 ENGINEER, routinely through the Resident Project Representative will make periodic visits to the site at intervals appropriate to the various stages of construction to observe the progress and general quality of the executed Work and to determine, in general, <u>for the benefit of OWNER only</u>, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site observations to check the quality or quantity of the Work, because <u>CONTRACTOR is solely responsible for same</u>. ENGINEER's efforts will be directed toward providing for <u>OWNER only</u>, a greater degree of confidence that the CONTRACTOR's completed Work will conform to the Contract Documents. On the basis of such limited visits and on-site observations as an experienced and qualified design professional, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to advise OWNER of any obvious defects and deficiencies in the Work.

On-Site Project Representation:

9.3 OWNER will generally furnish a Project Field Representative to assist ENGINEER in observing the daily performance of the Work for the sole benefit of the OWNER. This is an option available to OWNER that need not be exercised, nor may it be relied upon by the CONTRACTOR in any way to satisfy CONTRACTOR's quality control responsibility. The secondary duties, responsibilities and limitations of authority of any such OWNER Field Representative and any assistants will be determined by the OWNER.

Clarifications and Interpretations:

9.4 ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If CONTRACTOR believes that a written clarification or interpretation by ENGINEER justifies an increase in the Contract Price or an extension of the Contract Time, and the OWNER and CONTRACTOR are unable to agree to the basis, amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Article 11 or Article 12. Any increases or decreases in the Contract Price shall be governed by all State and local laws, statutes, codes, ordinances, rules and regulations governing public competitive bidding and Change Orders.

Authorized Variations in Work:

9.5 ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Time, and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER, and also on CONTRACTOR who shall promptly perform the Work involved. If CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time, CONTRACTOR may make a claim therefore as provided in Article 11 or 12. Any increases or decreases in the Contract Price shall be governed by all State and local laws, statutes, codes, ordinances, rules and regulations governing public competitive bidding and Change Orders.

Rejecting Defective Work:

9.6 ENGINEER will have the authority to disapprove or reject Work which ENGINEER believes to be defective, and will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7 In connection with ENGINEER's responsibility for Shop Drawings and samples, see paragraphs 6.25 through 6.30 inclusive.

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

9.9 In connection with ENGINEER's responsibilities in respect to Applications for Payment, etc., see Article 14.

Determinations for Unit Prices:

9.10 ENGINEER will determine the final actual quantities and classifications of any Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR, ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decisions thereon will be final and binding upon OWNER and CONTRACTOR.

Decisions on Disputes:

9.11 ENGINEER will be the interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work, and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Time, will be referred initially to ENGINEER in writing, with a request for a formal decision in accordance with this paragraph, which ENGINEER will render in writing within a reasonable time. Written notice of each such claim, dispute and other matter will be delivered by the claimant (OWNER or CONTRACTOR) to ENGINEER and opposing Party no later than thirty (30) calendar days after the occurrence of the event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other Party within sixty (60) calendar days after such occurrence, unless ENGINEER allows claimant an additional period of time in writing to ascertain more accurate data in support of the claim.

9.12 When functioning as interpreter and judge under paragraphs 9.10 and 9.11, it is hereby mutually agreed between OWNER and CONTRACTOR that ENGINEER will not be personally liable in connection with any non-negligent interpretation or decision rendered in good faith in such official and professional engineering capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 and 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.13) will be a condition precedent to any exercise by CONTRACTOR and/or OWNER of such rights or remedies they may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter.

Limitations on ENGINEER's Responsibilities:

9.13 Neither ENGINEER's authority to act under this Article 9, or elsewhere in the Contract Documents, nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority, shall give rise to any personal or corporate duty or responsibility of ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.

9.14 Whenever in the Contract Documents the terms: "as ordered"; "as directed"; "as required"; "as allowed"; "as approved"; or terms of like effect or import are used, or the adjectives: "reasonable"; "suitable"; "acceptable"; "proper"; or "satisfactory"; or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for general compliance with the Contract Documents (unless there is a specific statement

indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty to supervise or direct the furnishing, performance, or quality control of the CONTRACTOR's Work or any duty or authority to undertake responsibility of the CONTRACTOR contrary to the provisions of paragraph 9.15 or 9.16.

9.15 ENGINEER will not be responsible for CONTRACTOR's means, methods, techniques, quality control, sequences or procedures of construction, or the safety precautions and programs incident thereto, for which CONTRACTOR shall be solely responsible. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.16 ENGINEER will not be responsible for the acts and/or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

ARTICLE 10. CHANGES IN THE WORK

10.1 Without invalidating the Agreement and <u>without notice to any surety</u>, OWNER may, at any time, or from time to time, order additions, deletions or revisions in the Work that are in compliance with State public competitive bidding statutes and laws governing Change Orders; these will be authorized by a Written Amendment, a Change Order, or a Work Directive Change. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved, which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2 If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an increase or decrease in the Contract Price, or an extension or shortening of the Contract Time that should be allowed as a result of a Work Directive Change, a claim may be made therefore as provided in Article 11 or Article 12. All increases or decreases in the Contract Price shall be governed by all State and local laws, statutes, codes, ordinances, rules and regulations governing public competitive bidding and Change Orders.

10.3 CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.4 and 3.5, except in the case of an emergency as provided in paragraph 6.24, and except in the case of uncovering Work as provided in paragraph 13.9.

10.4 OWNER and CONTRACTOR may execute appropriate Change Orders (or Written Amendments) covering:

10.4.1 changes in the Work which are ordered by OWNER pursuant to paragraph 10.1; are required because of willing and informed acceptance of defective Work by OWNER under paragraph 13.13; or OWNER correcting defective Work under paragraph 13.14; or are otherwise agreed to by the Parties;

10.4.2 changes in the Contract Price or Contract Time which are agreed to by the Parties; and

10.4.3 changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, <u>but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the Progress Schedule as provided in paragraph 6.31</u>.

10.5 If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety <u>by CONTRACTOR</u>, the giving of any such notice will be <u>CONTRACTOR'S sole responsibility</u>, and the amount of each applicable Bond may be adjusted accordingly.

ARTICLE 11. CHANGE OF CONTRACT PRICE

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

11.2 The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an increase or decrease in the Contract Price shall be based on initial written notice delivered promptly by the CONTRACTOR or OWNER to the other Party, and to ENGINEER promptly (but in no event later than thirty (30) calendar days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall follow and be delivered within sixty (60) calendar days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim), and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant believes he is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11, if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid, and will be deemed legally waived under this Contract, if not submitted in accordance with this paragraph 11.2.

11.3 The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

11.3.1 Where the Work involved is covered by <u>unit prices</u> contained in the Contract Documents, by application of unit prices to the actual quantities of the Work items involved (subject to the provisions of paragraphs 11.9.1. through 11.9.3. inclusive).

11.3.2 By mutual acceptance of a <u>lump sum</u> (which may include an allowance for

overhead and profit <u>not</u> necessarily in accordance with paragraph 11.6.2.1).

11.3.3 On the basis of the <u>Cost of the Work</u> (determined as provided in paragraphs 11.4 and 11.5), plus a CONTRACTOR's Fee for overhead and profit (determined as provided in paragraphs 11.6 and 11.7).

Cost of the Work:

11.4 The term "Cost of the Work" means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the Cameron County, Texas area and shall include <u>only the following items</u>, and shall <u>not</u> include any of the costs itemized in paragraph 11.5:

11.4.1 Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under Schedules of Job Classifications as set forth by OWNER in the Supplementary Conditions of the Contract Documents. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of any fringe benefits, if any, which shall include social security contributions, unemployment, excise and payroll taxes, workers' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday, as may be applicable thereto. Such employees shall include superintendents and foremen at the Project site. The expenses of performing Work after regular daily working hours on Saturday, Sunday or on legal holidays shall be included in the above, to the extent authorized in an advanced written approval notice by OWNER.

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

11.4.3 Payments made by CONTRACTOR to the Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR, and shall deliver such bids to OWNER who will then determine which bid will be accepted. If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as CONTRACTOR's Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable. CONTRACTOR shall accomplish the applicability of the Contract Documents to Subcontractor agreements by using either "flow down" provisions or appropriate recitations in the subcontract agreements of parts of these Contract Documents.

11.4.4 Costs of special consultants (including but not limited to engineers,

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

11.4.5 Supplemental costs actually incurred including the following:

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

11.4.5.2 Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities <u>at the</u> <u>Project site</u> and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used, but not consumed, which remain the property of CONTRACTOR.

11.4.5.3 Rentals of all construction equipment and machinery and the parts thereof, whether rented from CONTRACTOR or others, in accordance with written rental agreements produced to OWNER as requested, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof (all in accordance with terms of said rental agreements). The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4 Any sales, consumer, use or similar taxes actually paid as related to the Work <u>that OWNER is not exempt from paying</u>, and for which CONTRACTOR is liable, as imposed by Laws and Regulations.

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

11.4.5.6 Losses and damages (and related expenses), <u>not</u> <u>compensated to CONTRACTOR by insurance or otherwise</u>, to the Work, or otherwise sustained by CONTRACTOR in connection with the proper performance and furnishing of the Work, provided they have resulted from causes <u>other than</u> the intentional and/or negligent acts and/or omissions of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them, or for whose acts and/or omissions any of them may be liable. Such losses shall include <u>settlements made with the advanced written consent and approval of OWNER</u>. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's Fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for reconstruction services, only at a fee proportionate to that stated in paragraph 11.6.2.

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

site.

11.4.5.8 Minor expenses such as telefaxes, long distance telephone calls, telephone service at the Project site, express mailings and similar petty cash items in connection with the Work.

11.4.5.9 Cost of premiums for any additional Bond and insurance coverages required because of any additive Change Orders to the Work.

11.5 The term "Cost of the Work" shall <u>not include any of the following</u>:

11.5.1 Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the Project site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon Schedule of Job Classifications referred to in paragraph 11.4.1, or specifically covered by paragraph 11.4.4, all of which are to be considered administrative costs covered by the CONTRACTOR's Fee.

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

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

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

11.5.5 Costs resulting from the intentional and/or negligent acts and/or omissions of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them, or for whose acts and/or omissions any of them may be liable, including but not limited to, the correction of defective Work, salvaging or disposal of materials or equipment wrongly supplied, and repairing any damage to real or personal property.

11.5.6 Other overhead or general expense costs of any kind and the costs of any item <u>not</u> specifically and expressly included in paragraph 11.4.

CONTRACTOR's Fee:

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

11.6.1 a mutually acceptable fixed fee; or if none can be agreed upon,

11.6.2 a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1 for costs incurred under paragraphs 11.4.1 and 11.4.2, the CONTRACTOR's Fee shall be fifteen (15%) percent;

11.6.2.2 for costs incurred under paragraph 11.4.3, the CONTRACTOR's Fee shall be five (5%) percent; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to CONTRACTOR on account of overhead and profit of <u>all Subcontractors</u> shall be fifteen (15%) percent;

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

11.6.2.4 the amount of credit to be allowed by CONTRACTOR to OWNER for any such Contract change which results in a net <u>decrease</u> in cost will be the amount of the actual net decrease, plus a deduction in CONTRACTOR's Fee by an amount equal to ten (10%) percent of the net decrease; and

11.6.2.5 when both additions and credits are involved in any one Contract change, the adjustment in CONTRACTOR'S Fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.4, inclusive.

11.7 Whenever the cost of any Work is to be determined pursuant to paragraph 11.4 or 11.5, CONTRACTOR will timely submit in a written form acceptable to ENGINEER, an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8 It is understood that CONTRACTOR has included in the Contract Price any and all allowances so named in the Contract Documents and shall cause the Work so covered thereby to be done by such Subcontractors or Suppliers, and for such sums within the limit of the allowances as may be acceptable to ENGINEER. CONTRACTOR agrees that:

11.8.1 Any allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Project site, and all applicable <u>non-exempt</u> taxes; and

11.8.2 CONTRACTOR's costs for managing on the Project site, labor, materials and equipment installation costs, overhead, profit and other expenses already contemplated for determining the allowances have been included in the Contract Price and <u>not in the allowances</u>. No demand for additional payment on account of any of such costs will be valid.

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

Unit Price Work:

11.9

11.9.1 Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work, multiplied by the estimated quantity of each item as indicated in the Agreement. <u>The ENGINEER'S estimated quantities of items of Unit Price Work are not guaranteed by the OWNER to be actually performed and are solely for the purpose of comparison of bids and determining an <u>initial Contract Price</u>. Determinations of the <u>actual</u> final quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with Paragraph 9.10.</u>

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

11.9.3 Where the quantity of any item of Unit Price Work performed by CONTRACTOR differs <u>materially and significantly</u> from the ENGINEER's estimated quantity of such item indicated in the Contract Documents (generally plus or minus fifteen percent (15%), and there is no corresponding and offsetting adjustment(s) with respect to any other Unit Price item(s) of Work, and if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof, CONTRACTOR may make a timely claim for an increase in the Contract Price in accordance with Article 11 and any applicable State law, if the Parties are unable to otherwise agree as to the amount of any such increase. OWNER is also able to file a similar timely claim with ENGINEER if OWNER believes that the <u>quantity</u> of Unit Price Work items has <u>significantly increased</u> to the point that OWNER believes it is owed a credit from CONTRACTOR for any volume discount pricing that CONTRACTOR should have received by purchasing such additional quantities.

ARTICLE 12 -- CHANGE OF CONTRACT TIME

12.1 The Contract Time may only be changed by a Change Order or a Written Amendment. Any claim for an extension or shortening of the Contract Time shall be based on initial written notice delivered by the CONTRACTOR or OWNER to the ENGINEER and to the other Party (but in no event later than thirty (30) calendar days) after the occurrence of the event giving rise to the claim, and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall follow and be delivered within sixty (60) calendar days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the time adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by ENGINEER in accordance with paragraph 9.11, if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid and will be

deemed legally waived under this Contract, if not submitted in accordance with the requirements of this paragraph 12.1.

12.2 The Contract Time will be extended in an amount equal to time lost due to delays beyond the reasonable control of CONTRACTOR, so long as CONTRACTOR has made good faith efforts to mitigate delaying impacts and if a claim is made therefore as provided in paragraph 12.1. Such delays shall include, but not be limited to, acts, omissions, or neglect by OWNER or others performing additional separate work as contemplated by Article 7, or to fires, floods exceeding the 100 year frequency in Cameron County, labor disputes, epidemics, extremely abnormal weather for Cameron County, Texas, as may be described further in these Contract Documents, or Acts of God.

12.3 ALL TIME LIMITS STATED IN THE CONTRACT DOCUMENTS ARE MUTUALLY AGREED TO BE OF THE ESSENCE OF THE AGREEMENT. The provisions of this Article 12 shall <u>not exclude</u> recovery for damages (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court costs) for delay <u>by either Party</u>.

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

Warranty and Guarantee:

CONTRACTOR warrants and guarantees to OWNER that all Work will be in 13.1 accordance with the Contract Documents and will not be defective. Prompt notice of any obvious patent Work defects discovered by OWNER or ENGINEER shall be promptly given to CONTRACTOR in writing. All defective Work, whether or not in place, may be rejected, corrected or accepted as provided in this Article 13. In case of dispute as to the cause of improper functioning of all or any part of the Work, the burden of proof that CONTRACTOR has complied with the Contract Documents rests with CONTRACTOR for this Work. He shall submit in writing to ENGINEER his opinion and basis of proof for the adequacy of his Work. OWNER may have those tests made, which OWNER deems advisable, by an independent testing laboratory of OWNER's choice. If any test so made indicates a defect in material or workmanship, or that one or more manufactured components of the Work are performing below the standard set by the manufacturer's public data and specifications, or the Specifications of these Contract Documents, the entire cost of all such tests shall be paid for by CONTRACTOR, and he shall also pay for retesting of the corrected Work, until in the ENGINEER's opinion, it functions satisfactorily. The Work shall be guaranteed to be free from defects due to faulty workmanship or material for a period of one (1) year from the date of OWNER issue of the Certificate of Acceptance. Work found to be improper or imperfect shall be replaced or redone without cost to OWNER within the one year guarantee period. Neither the Certificate of Acceptance, final payment, or any other provision of the Contract Documents shall relieve CONTRACTOR from his workmanship guarantee. Failure of CONTRACTOR to repair or replace faulty Work entitles OWNER to repair or replace the same and recover the costs from CONTRACTOR and/or his Surety. CONTRACTOR shall be the sole guarantor of the Work installed under this Contract and no third party guarantees/warranties by Subcontractors or suppliers of various components or materials will

be acceptable; nor shall agreements with Subcontractors or material or component suppliers by CONTRACTOR reduce CONTRACTOR's sole responsibility to OWNER under this Agreement. All equipment shall be warrantied and/or guaranteed by either CONTRACTOR or its supplier/manufacturer by assignment to OWNER, for at least one (1) year from the date of OWNER acceptance of the entire Project. It is anticipated by OWNER and acknowledged by CONTRACTOR that many equipment and material warranties from suppliers/manufacturers shall extend well beyond the initial one (1) year post acceptance period. The CONTRACTOR shall transfer by assignment to the OWNER any and all third party supplier and manufacturer warranties and/or guaranties that remain in effect beyond the one (1) year workmanship guarantee/warranty period. At the option of the OWNER, all materials/equipment are also warrantied or guaranteed to OWNER for one (1) year from the date of any early partial acceptance of Work, and beneficial use of a completed system component of Work prior to full integration with the entire completed Project.

Access to Work:

13.2. ENGINEER AND ENGINEER's representatives, other representatives of OWNER, testing agencies and governmental agencies with jurisdictional interests, will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall promptly provide proper and safe conditions for such authorized and identified reasonable access in accordance with any Occupational Safety and Health Administration (OSHA) and CONTRACTOR's safety program and insurance requirements.

It is agreed by CONTRACTOR that OWNER shall be and is hereby authorized to appoint from time to time, OWNER's subordinate supervisors, observers, and/or inspectors, as the OWNER may deem proper to inspect the material furnished and observe the Work performed under this Agreement, and to see that the material is furnished and Work is generally performed in accordance with the Specifications. This OWNER function, for OWNER's sole benefit, does not excuse the CONTRACTOR from his own quality control assurance, which is solely his responsibility. CONTRACTOR shall furnish all reasonable aid and assistance required by the ENGINEER, and OWNER's subordinate supervisors, observers and/or inspectors to perform observation, inspection and examination of the Work and all parts of the Work. CONTRACTOR shall regard and obey the directions and instructions of the ENGINEER and any OWNER subordinate supervisors, observers and/or inspector so appointed, when such directions are consistent with the obligations of the Contact Documents and included Specifications, provided, however, that should CONTRACTOR object to any order by any OWNER subordinate supervisor or inspector, CONTRACTOR may within ten (10) calendar days submit written notice to ENGINEER for his decision. Except as herein before provided, the authority of OWNER's subordinate supervisors or inspectors shall be limited to the rejection of unsatisfactory Work and materials and to the potential short-term suspension of the Work, until the questions of Work acceptability can be referred to ENGINEER.

13.2.1. CONTRACTOR shall cooperate with any OWNER-provided testing laboratory for the purpose of allowing services of the laboratory to be timely and properly performed. CONTRACTOR shall provide OWNER's representative and testing laboratory a minimum of twenty-four (24) hours notice of readiness for all testing as required by the Specifications or customary construction industry standards. OWNER shall bear the cost of <u>density and concrete</u> testing, for the first test only. <u>Testing of equipment, lines and valves</u> shall be the responsibility of CONTRACTOR and he shall notify ENGINEER and OWNER's Field Representative of his scheduled time for such tests, so that the test can be witnessed by ENGINEER and OWNER'S Field Representative. If initial tests show failure, the CONTRACTOR shall incur the non-reimbursable costs of retesting the areas that failed after CONTRACTOR's corrective action has been taken, including the per diem personnel and equipment costs incurred by OWNER in said retesting. The per diem costs shall be determined based on the hourly wage plus reasonable overhead of ENGINEER's and OWNER's personnel needed to be present at the Project site during retesting, and by the locally prevailing rental rate for the vehicles and equipment utilized in retesting. These retesting costs shall be paid by CONTRACTOR prior to OWNER's interim conditional acceptance of the Work improvements.

Tests and Inspections:

13.3. CONTRACTOR shall give ENGINEER and /or OWNER's Field Representative timely notice of readiness of the Work for all required inspections, tests or approvals.

13.4. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefore, pay all costs as included in the Contract Price in connection therewith, and furnish ENGINEER the required final certificates of inspection, testing or approval. CONTRACTOR shall also be responsible for and shall pay all non-reimbursable costs in connection with any special inspection or testing required in connection with OWNER's or ENGINEER's approval and acceptance of an alternative Supplier of "or equal" proposed substitutions of materials or equipment proposed by CONTRACTOR to be incorporated in the Work, or of alternative materials or equipment submitted for approval <u>prior to CONTRACTOR's and approvals</u>, other than any of those special inspections which may be required by the Contract Documents to be paid by CONTRACTOR, <u>shall be paid by OWNER</u> (unless otherwise specified).

13.5 All inspections, tests or approvals, other than those required by Laws or Regulations of any public body having jurisdiction, shall be performed by organizations acceptable to OWNER (or by ENGINEER, if so specified).

13.6 If any Work (including the work of others) that is to be inspected, tested or approved is backfilled or otherwise built-in or concealed by CONTRACTOR without written concurrence of ENGINEER, it must, if requested in writing by ENGINEER, be uncovered and revealed for ENGINEER's Resident Project Representative and OWNER Field Representative observation. Such uncovering shall be at CONTRACTOR's non-reimbursable expense, unless CONTRACTOR has given ENGINEER timely written notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness (not to exceed three (3) days) in written response to such CONTRACTOR notice.

13.7 Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from <u>CONTRACTOR's sole obligations</u> to perform the Work and

<u>constantly employ quality control</u> in accordance with the Contract Documents. **Uncovering Work:**

13.8 If any Work is backfilled contrary to the advanced written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's non-reimbursable expense.

13.9 If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's written request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question shall be uncovered by CONTRACTOR by furnishing all necessary labor, material and equipment to uncover same. If it is found that such Work is defective, CONTRACTOR shall bear all direct, indirect and consequential non-reimbursable costs of such uncovering, exposure, observation, inspection and testing, and of the satisfactory repair, replacement and reconstruction, (including but not limited to fees and charges of ENGINEER, architects, attorneys and other professionals), and OWNER shall be entitled to an appropriate decrease in the Contract Price for that portion of these costs that CONTRACTOR does not otherwise reimburse to OWNER; and if the Parties are unable to agree as to the amount thereof, OWNER may make a claim therefore as provided in Article 11. If, however, such Work is not found to be defective, CONTRACTOR may be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, repair, replacement and reconstruction; and, if the Parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12. All increases or decreases in the Contract Price shall be governed by all State and local laws, statutes, codes, ordinances, rules and regulations governing public competitive bidding and Change Orders.

Owner May Stop the Work:

13.10 If the Work is defective in the opinion of the ENGINEER and OWNER, or CONTRACTOR fails to supply sufficient skilled workers, Subcontractors, or suitable materials or equipment, or otherwise fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, <u>OWNER may issue a written order for CONTRACTOR to stop the Work</u>, or any portion thereof, until the cause for such stop Work order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR, or any other entity.

Correction or Removal of Defective Work:

13.11 If required by ENGINEER, CONTRACTOR shall promptly, as directed in writing, either correct all defective Work, whether or not fabricated, installed or completed, if the Work has been rejected by ENGINEER, and remove it from the Project site and replace it with non-defective Work. CONTRACTOR shall bear all direct, indirect and consequential non-reimbursable costs of such correction or removal (including but not limited to fees and charges of ENGINEER, architects, attorneys and other professionals) made necessary thereby.

One Year Workmanship Correction Period:

13.12 If within one (1) year after the date of OWNER issuance of the Certificate of Acceptance, or such longer period of time as may be prescribed by Laws or Regulations, or by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions, either correct such defective Work, or, if it has been rejected by OWNER, remove it from the Project site and replace it with non-defective Work. If CONTRACTOR does not promptly comply with the terms of such OWNER instructions, or in an emergency where CONTRACTOR delay would cause serious risk of loss or damage to OWNER's facilities, OWNER may have the defective Work corrected, or the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement (including but not limited to fees and charges of ENGINEER, architects, attorneys and other professionals) will be charged to and paid by CONTRACTOR. In special circumstances, where a particular item of equipment is placed in continuous service by OWNER before acceptance of all the Work, the minimum one (1) year workmanship guarantee and/or equipment warranty correction periods for that item may start to run from an earlier date, if so provided in the Specifications or by Written Contract Amendment.

Acceptance of Defective Work:

13.13 If instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER's recommendation of final Project payment), prefers to accept it "as is," OWNER may do so in writing. CONTRACTOR shall bear all reasonable direct, indirect and consequential non-reimbursable costs attributable to OWNER's evaluation of, and determination to accept such defective Work (such OWNER costs to be approved by ENGINEER as to reasonableness and may include but not be limited to fees and charges of ENGINEER and any OWNER's, architects, attorneys and other professionals). If any such OWNER acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions to the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the Parties are unable to agree as to the amount thereof, OWNER or CONTRACTOR may make a written claim therefore as provided in Article 11. If the acceptance occurs after such final Project payment, an appropriate amount as determined by OWNER will be charged to and paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14 If CONTRACTOR fails within seven (7) calendar days after written notice by ENGINEER to proceed to correct, and to actually correct defective Work; or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11; or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents; or if CONTRACTOR fails to comply with any other provision of the Contract Documents; OWNER may, after the pre-requisite seven (7) calendar days written notice to CONTRACTOR, correct and remedy any such CONTRACTOR deficiency. In exercising the rights and remedies under this

paragraph, OWNER shall proceed with reasonable expediency. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Work and Project site; take possession of all or part of the Work; and temporarily suspend CONTRACTOR's Work related thereto; take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Project site; and incorporate in the Work all Project materials, and CONTRACTOR shall allow OWNER and ENGINEER, representatives and employees such access to the Project site as may be necessary to enable OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs of OWNER in exercising such rights and remedies will be charged against CONTRACTOR, in an amount approved as to reasonableness by ENGINEER, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the Parties are unable to agree as to the amount thereof, OWNER or CONTRACTOR may make a claim therefore as provided in Article 11. Such direct, indirect and consequential OWNER costs will include, but not be limited to: fees and charges of ENGINEER; OWNER's architects; attorneys; and other professionals; all court costs; and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's defective Work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies under this paragraph 13.4.

ARTICLE 14 -- PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1 The Schedule of Values established as provided in paragraph 2.9 will serve as the basis for monthly progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units actually completed, multiplied by the per unit price. CONTRACTOR, ENGINEER and OWNER shall also mutually address in the Schedule of Values any periodic CONTRACTOR reimbursements or direct OWNER payments to third-party vendors producing any specially fabricated goods and equipment with longer lead times prior to delivery to the Project site.

Application for Progress Payment:

14.2 At least twenty (20) calendar days before each progress payment is scheduled (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review, an Application for Payment accurately completed and signed by CONTRACTOR, covering the Work completed as of the date of the Application, and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment <u>not</u> incorporated in the Work, but delivered and suitably stored at the Site, or at another bonded and insured secure location off the nearby Project site as agreed to in an advanced writing signed by CONTRACTOR and OWNER, the Application for Payment shall also be accompanied by a bill of sale, invoice, affidavit of bill(s) paid, or other documentation warrantying that OWNER has actually received the title ownership of Project materials and equipment still within the care,

custody and control of CONTRACTOR for Project Work purposes and free and clear of any attempted liens, charges, security interests and encumbrances (which are hereinafter in these General Conditions referred to as "Encumbrances"), and evidence that the materials and equipment are covered by appropriate property insurance and other security arrangements to protect OWNER's legal interest therein, all of which will be satisfactory to OWNER. The amount of OWNER retainage with respect to progress payments, five percent (5%), is stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3 CONTRACTOR warrants and guarantees that title to any Work equipment and materials itemized in any Application for Payment, whether incorporated in the Project, or delivered and stored at or nearby the Project site, will pass to OWNER no later than the time of any progress payment, free and clear of any and all Encumbrances.

Review of Applications for Progress Payment:

14.4 ENGINEER will, within twenty (20) calendar days after <u>receipt</u> of each Application for Payment from CONTRACTOR, either indicate in writing a recommendation for OWNER payment and process the Application, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR will make the necessary corrections and promptly resubmit the Application. Twenty (20) calendar days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the payment amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due, and when due will be promptly paid by OWNER to CONTRACTOR, preferably by electronic transfer.

ENGINEER's recommendation of any payment requested in an Application for 14.5 Payment will constitute a representation by ENGINEER to OWNER, based upon ENGINEER's limited periodic on-site observations of the Work in progress as an experienced and qualified design professional; and on ENGINEER's review of the Application for Payment and the accompanying data and Schedules; that the Work has progressed to the estimated percentage completion point indicated, that, to the best of ENGINEER's knowledge, information and belief, the status of the Work is in apparent general accordance with the Contract Documents (subject to: a later evaluation of the Work as a functioning whole; prior to or upon Substantial Completion; and subject to the results of any subsequent tests called for in the Contract Documents; and subject to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10; and subject to any other qualifications stated in the ENGINEER's recommendation to OWNER); and that CONTRACTOR is entitled to payment of the amount recommended. However, by recommending any such payment, ENGINEER will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the CONTRACTOR's quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents, or that there may not be other matters or issues between the Parties that might entitle CONTRACTOR to be paid additionally by OWNER, or OWNER to withhold payment to CONTRACTOR.

14.6 ENGINEER's recommendation of final Project payment will constitute an additional representation by ENGINEER to OWNER that to the best of ENGINEER's knowledge, the conditions precedent to CONTRACTOR's being entitled to final Project payment, as set forth in paragraph 14.13, have been fulfilled.

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

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

Order.

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

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

14.7.4 because of ENGINEER's actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.9 inclusive.

OWNER may for its own benefit and protection <u>and not for the direct benefit of any third parties</u>, refuse to make CONTRACTOR payment in whole or in part of the amount recommended by ENGINEER, because claims have been made against OWNER on account of CONTRACTOR's improper performance of the Work; or payment bond claims and inquiries have been filed with OWNER or surety by third-parties in connection with the Work and OWNER may wish to consult with CONTRACTOR and/or CONTRACTOR's surety about the status of CONTRACTOR subtier payments, or there are other items entitling OWNER to a set-off against the payment amount recommended, but OWNER must give CONTRACTOR written notice stating the reasons for any non-payment to CONTRACTOR.

Substantial Completion:

14.8 When CONTRACTOR considers the entire Work ready for OWNER's intended purpose and use, CONTRACTOR shall notify ENGINEER in writing that the entire Work is Substantially Complete (except for minor items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, ENGINEER and CONTRACTOR shall make a joint inspection of the Work to determine the status of Project completion. If ENGINEER does not consider the Work Substantially Complete, ENGINEER will promptly notify CONTRACTOR in writing giving the reasons therefore. If ENGINEER considers the Work Substantially Complete, ENGINEER will prepare and deliver to OWNER a <u>tentative</u> certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of pending Work items to be completed or corrected by CONTRACTOR before final payment ("punch-list"). OWNER shall have ten (10) calendar days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not Substantially Complete, ENGINEER will within twenty (20) calendar days after submission of the tentative certificate to OWNER, notify CONTRACTOR in writing, stating the reasons for no accomplishment of Substantial Completion. If, after consideration of OWNER's written objections regarding non-issuance of a Substantial Completion certificate, ENGINEER considers the Work Substantially Complete, ENGINEER will within said twenty (20) calendar days execute and deliver to OWNER and CONTRACTOR, a definitive certificate of Substantial Completion (with a final punch list of items to be completed or corrected) reflecting such changes from the tentative list as ENGINEER believes justified, after consideration of any objections from At the time of delivery of the definitive certificate of Substantial Completion, OWNER. ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to any Project security, operation, safety, maintenance, HVAC, utilities, insurance, warranties, and guarantees. OWNER and CONTRACTOR shall agree in writing regarding the final division of responsibilities, and so inform ENGINEER.

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

Partial Utilization:

14.10 Use by OWNER of any finished part of the Work, which has specifically been identified in the Contract Documents, or which OWNER, ENGINEER and CONTRACTOR subsequently agree constitutes a separately functioning and useable part of the Work that can be utilized by OWNER without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work, subject to the following:

14.10.1 OWNER at any time may request CONTRACTOR in writing to permit OWNER to <u>use</u> any such part of the Work which OWNER believes to be ready for OWNER's intended <u>use and purpose</u> and Substantially Complete. If CONTRACTOR agrees, CONTRACTOR will certify in writing to OWNER and ENGINEER that said part of the Work is Substantially Complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Additionally, CONTRACTOR at any time may notify OWNER and ENGINEER in writing, that CONTRACTOR considers any such part of the Work ready for OWNER's intended <u>use and purpose</u>, and substantially complete, and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after such CONTRACTOR request, OWNER, ENGINEER and CONTRACTOR shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER considers that part of the Work to be Substantially Complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to issuance of any certification of Substantial Completion for that part of the Work, and finalizing the division of responsibilities and access thereto.

14.10.2 OWNER may at any time request CONTRACTOR in writing to permit OWNER to take over operation of any such part of the Work, although it is not Substantially Complete. A copy of such request will be sent to ENGINEER and within a reasonable time thereafter, OWNER, ENGINEER and CONTRACTOR shall make an inspection of that part of the Work to determine its status of completion and will prepare a punch-list of the items remaining to be completed or corrected thereon before final payment. If CONTRACTOR does not object in writing to OWNER and ENGINEER within seven (7) calendar days that such part of the Work is not ready for separate operation by OWNER, ENGINEER will finalize the list of items to be completed or corrected and will deliver such list to OWNER and CONTRACTOR, together with a written statement as to the division of responsibilities pending final payment between OWNER and CONTRACTOR, with respect to security, operation, safety, maintenance, HVAC, utilities, insurance, warranties and guarantees for that part of the Work, which will become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing and so informed ENGINEER). During such OWNER operation and prior to Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on any punch list, and to complete other related Work.

14.10.3 No OWNER use, occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.9 in respect of CONTRACTOR's property insurance notice and endorsement.

Final Inspection:

14.11 Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars (a revised short-list) in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such corrective measures as are necessary to remedy such remaining deficiencies.

A qualified person(s) representing CONTRACTOR shall be present at this final inspection. Prior to this inspection, all Work shall have been completed, tested, adjusted and in final operating condition, if required by the Project Specifications.

Final Application for Payment:

14.12 After CONTRACTOR has completed all such final Work corrections to the satisfaction of ENGINEER and delivered certificates of inspection, marked-up record documents, if any, depicting as-built conditions (as provided in paragraph 6.21) and other important documents--all as required by the Contract Documents; and after ENGINEER has indicated that the Work is acceptable (subject to the provisions of paragraph 14.16), CONTRACTOR may make application for final payment following the procedure for monthly progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together with complete and legally effective releases or waivers (satisfactory to

OWNER) of all third-party claims arising out of, or filed in connection with the Work. In lieu thereof and as approved by OWNER, CONTRACTOR may furnish third-party receipts or releases in full; a sworn affidavit of CONTRACTOR that the releases and receipts include prior CONTRACTOR payments for all labor, services, material and equipment for which a timely Payment Bond claim could be filed, and that all payrolls, material and equipment bills, and other CONTRACTOR indebtedness connected with the Work, for which OWNER or OWNER's property might in any way be encumbered, have been paid or otherwise satisfied; and a written consent of the Surety to OWNER's final payment, if any is required by CONTRACTOR's Surety. IF ANY SUBCONTRACTOR OR SUPPLIER FAILS TO FURNISH CONTRACTOR A RELEASE OR RECEIPT IN FULL, CONTRACTOR MAY FURNISH A SPECIAL INDEMNITY BOND, OR OTHER COLLATERAL SATISFACTORY TO OWNER, TO INDEMNIFY, HOLD HARMLESS, AND FULLY PROTECT OWNER AGAINST ANY POTENTIAL THIRD-PARTY CLAIM.

Final Payment and Acceptance:

14.13 If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment, and accompanying documentation (all as required by the Contract Documents), ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within twenty (20) calendar days after receipt of the final Application for Payment, indicate in writing, ENGINEER's recommendation to OWNER for payment and process the Application for Payment. Thereupon ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable, subject to the provisions of paragraph 14.16. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall promptly make the necessary corrections and resubmit the Application. Thirty (30) calendar days after presentation to OWNER of the final Application for Payment and accompanying documentation, in appropriate final form and substance, and with ENGINEER's recommendation and notice of acceptability, the final amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

CONTRACTOR shall submit satisfactory evidence to the OWNER and ENGINEER that all payrolls, and other CONTRACTOR indebtedness connected with the Work have been paid, before a Final Certificate of Acceptance is issued.

14.14 If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the partial payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such Payment. Such partial payment shall be made under the terms and conditions governing final payment, except that it shall not

constitute a final waiver of claims by OWNER.

Contractor's Continuing Obligation:

14.15 <u>CONTRACTOR'S obligation to perform and complete the Work in accordance</u> with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by ENGINEER; nor the issuance of a Certificate of Substantial Completion or Final Acceptance; nor any payment by OWNER to CONTRACTOR under the Contract Documents; nor any use or occupancy of the Work or any part thereof by OWNER; nor any act of Work acceptance by OWNER; nor any failure to do so; nor the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13; nor any correction of defective Work by OWNER, will constitute an acceptance of Work not in accordance with the Contract Documents, or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents (except as provided in paragraph 14.16).

Waiver of Claims:

14.16 The making and acceptance of final payment will constitute:

14.16.1 a waiver of all claims by OWNER against CONTRACTOR, <u>except</u> any timely filed third party claims arising from unsettled payment bond claims; <u>from latently</u> <u>defective Work</u> appearing after final inspection pursuant to paragraph 14.11; or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will <u>not</u> constitute a waiver by OWNER of any rights regarding CONTRACTOR's continuing obligations under the Contract Documents; and

14.16.2 <u>a waiver of all claims by CONTRACTOR against OWNER, other</u> than those previously, properly, and timely made in writing and still unsettled.

ARTICLE 15 -- SUSPENSION OF WORK AND TERMINATION

Owner May Suspend Work:

15.1 <u>OWNER may, at any time and without cause, suspend the Work or any portion</u> thereof for a period of not more than ninety (90) cumulative (not necessarily consecutive) calendar days by notice in writing to CONTRACTOR and ENGINEER, which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR may be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension, if CONTRACTOR demonstrates an approved claim therefore as provided in Articles 11 and 12. Any increase or decrease in the Contract Price shall be governed by all State and local laws, statutes, codes, ordinances, rules and regulations governing public competitive bidding and Change Orders.

Owner May Terminate:

15.2 Upon the occurrence of <u>any one or more</u> of the following events:

15.2.1 if CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise, under any other federal or Texas law in effect at such time, relating to the bankruptcy or insolvency;

15.2.2 if a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or Texas law in effect at the time relating to bankruptcy or insolvency;

15.2.3 if CONTRACTOR makes a general assignment for the benefit of creditors;

15.2.4 if a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of the property of CONTRACTOR is for the purpose of enforcing a lien against such CONTRACTOR property, or for the purpose of general administration of such CONTRACTOR property, for the benefit of CONTRACTOR's creditors;

15.2.5 if CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

15.2.6 if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including but not limited to, failure to supply sufficient skilled workers or equipment, or failure to adhere to the Progress Schedule established under paragraph 2.9, as revised from time to time);

15.2.7 if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.8 if CONTRACTOR disregards the rights of OWNER; or

15.2.9 if CONTRACTOR otherwise violates in any substantial and material way, any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR and the surety seven (7) calendar days written notice, and to the extent permitted by Laws and Regulations: <u>terminate the services</u> of CONTRACTOR; exclude CONTRACTOR from the Project site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the Project site; and use the same to the full extent they could be used by CONTRACTOR (<u>without OWNER liability to CONTRACTOR for trespass or conversion</u>), and finish the Work as OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. <u>If</u> the unpaid balance of the Contract Price exceeds the OWNER's direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of ENGINEER, other engineers, architects, attorneys and other professionals and court costs), such excess <u>will be paid to CONTRACTOR or surety</u>. <u>If such OWNER costs exceed such</u>

unpaid balance of the Contract Price, CONTRACTOR or surety shall pay the difference to <u>OWNER</u>. Such costs incurred by OWNER will be approved as to reasonableness by ENGINEER and incorporated in a Change Order, but when exercising any rights or remedies under this paragraph, <u>OWNER shall not be required to obtain the lowest price for the Work performed</u>.

15.3 Where CONTRACTOR's <u>services have been so terminated</u> by OWNER, that <u>termination will not affect any rights or remedies of OWNER under this continuing Agreement</u> <u>against CONTRACTOR then existing, or which may thereafter accrue</u>. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from ongoing liability under this Agreement.

15.4 Upon seven (7) calendar days written notice to CONTRACTOR and ENGINEER, OWNER may, <u>without cause</u> and without prejudice to any other right or remedy, elect to abandon the Work and <u>terminate the Agreement for OWNER's convenience</u>. In such case, CONTRACTOR shall mitigate demobilization costs as best as possible and be paid for all Work properly executed and expenses sustained, plus reasonable termination expenses, which will include, but not be limited to, direct, indirect and consequential costs (including, but not limited to, fees and charges of CONTRACTOR's engineers, architects, attorneys and other professionals).

ARTICLE 16 -- TIME FOR SUBSTANTIAL COMPLETION AND LIQUIDATED DAMAGES.

16.1. IT IS HEREBY UNDERSTOOD AND MUTUALLY AGREED, BY AND BETWEEN THE PARTIES HERETO, THAT THE DATE OF BEGINNING, RATE OF PROGRESS AND THE TIME FOR SUBSTANTIAL COMPLETION OF THE WORK TO BE PERFORMED HEREUNDER ARE ESSENTIAL CONDITIONS OF THIS CONTRACT; and it is further mutually understood and agreed, by and between the Parties hereto, that the time to perform the Work embraced in this Contract shall be commenced on a date to be specified in the Notice to Proceed.

16.2 <u>CONTRACTOR hereby agrees that said Work shall be prosecuted regularly,</u> <u>diligently, and uninterrupted at such rate of progress as will insure Substantial Completion thereof</u> <u>within the time specified. It is expressly understood and mutually agreed, by and between the</u> <u>Parties hereto, that the time for the Substantial Completion of the Work described herein in</u> <u>calendar days is a reasonable time for Substantial Completion of same, taking into consideration</u> <u>the average climatic range and weather conditions the CONTRACTOR must reasonably anticipate</u> <u>is already included in the calculation of the performance time specified herein, and</u> <u>CONTRACTOR has assessed the usual industrial and labor conditions prevailing in the Cameron</u> <u>County area</u>.

16.3 If CONTRACTOR shall neglect, fail or refuse to Substantially Complete the Work within the mutually agreed to time herein specified, then CONTRACTOR does hereby agree, as a part of the consideration for the awarding of this Contract, to pay the OWNER the mutually agreed to amount specified in the Construction Agreement, <u>not as a penalty, but as liquidated damages</u> for such breach of Contract <u>for each and every calendar day that CONTRACTOR shall be in</u> <u>default</u>, after the time stipulated in the Contract Documents for Substantially Completing the

Work.

16.4 The damage to OWNER by reason of this Work not being Substantially Completed as of the mutually agreed to performance time period are incapable of definite ascertainment by either Party, and therefore the Parties hereto have mutually fixed and limited such damages to the sum stipulated in the Construction Agreement for each calendar day the Project runs beyond such Substantial Completion date, and the mutual agreement for such damages constitutes a part of the consideration for entering the Agreement. It is further mutually agreed that **TIME IS OF THE ESSENCE** for each and every portion of this Agreement and of the Specifications, wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract, any additional time is allowed for the Substantial Completion of any Work, the new time fixed by such extension shall also be **OF THE ESSENCE** for this Agreement. Provided that CONTRACTOR shall not be assessed with the mutually agreed to liquidated damages or any excess cost when the delay in the Substantial Completion of Work is due:

16.4.1 To any preference, priority or allocation order duly issued by the United States Federal Government.

16.4.2 To unforeseeable causes beyond the control and without the fault or negligence of CONTRACTOR, including, but not restricted to: Acts of God; or of the public enemy; acts of the OWNER; acts of another contractor in the performance of a separate contract with the OWNER; fires; floods exceeding the 100 year frequency in Cameron County, Texas; epidemics; quarantine restrictions; strikes; freight embargoes and unusually severe weather not customary for the Cameron County, Texas area and not already included in the calculation of the performance time specified herein.

16.4.3 To any delays of Subcontractors and/or CONTRACTOR's equipment/material suppliers occasioned by any of the causes specified in 16.4.1 or 16.4.2.

16.4.4 Provided further, that CONTRACTOR shall immediately attempt to mitigate the impacts of the delay, and within seven (7) calendar days from the beginning of such delay, notify OWNER, in writing, of the causes for the delay. ENGINEER and OWNER shall then ascertain the facts and extent of the delay and OWNER will notify CONTRACTOR within a reasonable time of OWNER's decision in the matter regarding any adjustment to the Contract Time and a mutually acceptable Project Schedule recovery plan.

ARTICLE 17 -- MISCELLANEOUS

Giving Notice:

17.1 Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly performed if delivered in person to the CONTRACTOR's Project Superintendent or mailed to an officer of the corporation in the case of the CONTRACTOR; or to the General Manager and CEO of the BPUB in the case of the OWNER; or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the provider of the notice. **PROVIDING TIMELY NOTICE AS REQUIRED BY**

THE NUMEROUS PARAGRAPHS HEREIN IS A MUTUALLY AGREED TO ESSENTIAL <u>TERM</u> OF THIS CONTRACT FOR BOTH PARTIES, AND FAILURE TO PROVIDE SAME CONSTITUTES A MATERIAL BREACH OF THE CONTRACT AND A WAIVER OF CERTAIN REMEDIES THAT OTHERWISE WOULD HAVE BEEN AVAILABLE TO A PARTY HEREUNDER HAD PROPER TIMELY NOTICE BEEN PROVIDED.

Computation of Calendar Day Time:

17.2 When any period of time is referred to in the Contract Documents by "days", and the OWNER'S format for scheduling the performance time on the Project is by utilizing <u>calendar</u> <u>days</u> in lieu of "working days," it will be computed as <u>calendar days</u>, to exclude the first and <u>include the last calendar day of such measured period</u>. If the last calendar day of any such period falls on a calendar day listed as a local BPUB holiday by the Contract Documents, such calendar day will be omitted from the computation.

17.2.1 A calendar day consists of twenty-four (24) hours and is measured from midnight on one day, to the next midnight, and shall constitute a single calendar day.

General:

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

The duties and obligations imposed by these General Conditions and the rights and 17.4 remedies available hereunder to the Parties hereto, and, in particular but without limitation, the conditions, warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.32, 13.1, 13.12, 13.14, 14.3 and 15.2, and all of the rights and remedies available to OWNER thereunder; are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to OWNER which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this paragraph 17.4 will be as effective as if repeated specifically in all the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply. All representations, conditions, warranties and guarantees made in the Contract Documents will survive the execution, final payment and termination or completion of the Agreement. All CONTRACTOR recitations contained in any document required by OWNER, whether delivered at the time of the execution of the Construction Agreement, or at a later date, shall constitute legal and binding representations, warranties and guarantees by CONTRACTOR herein.

17.5 CONTRACTOR shall comply with the "anti-kickback" provisions of the Copeland

Act now codified at 18 U. S. C. A. §874, and all amendments or modifications of the original Act of June 13, 1934.

SUPPLEMENTARY CONDITIONS

SECTION 1 - WAGE AND LABOR STANDARD PROVISIONS - 100% <u>NON</u> - FEDERALLY FUNDED CONSTRUCTION

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1. <u>GENERAL STATEMENT</u>

This is a <u>100% Non-Federally funded</u> and competitively bid Public Works Contract and Article 5159a, Revised Civil Statutes of Texas, as amended, requires that not less than the general prevailing wage rates (minimum hourly base pay and minimum hourly fringe benefit contribution) for work of similar character be paid to Contractor and Subcontractor employees. <u>These local</u> <u>prevailing and adopted wage rates are derived from the most current applicable federal prevailing</u> <u>wage rates for</u> Cameron County, Texas as published by the United States Department of Labor, (DOL) Dallas, Texas. Copies of the wage rates applicable to the Project at the time of bidding are contained at the end of this Supplementary Conditions Section 1, and are included instruments of this Contract and full compliance with same shall be required.

Any deviation from Wage and Labor Standard Provisions compliance may be cause for OWNER's withholding either interim or final payment to the CONTRACTOR until such deviations are properly corrected.

2. <u>OWNER'S FINANCE DEPARTMENT WAGE & HOUR OFFICE, PROJECT</u> <u>RESPONSIBILITIES</u>

The OWNER's FINANCE DEPARTMENT is primarily responsible for all Wage and Labor Standard Provisions investigation and enforcement and will monitor CONTRACTOR/Subcontractor practices to assure the OWNER that:

- a. Appropriate weekly compliance statements and payroll records are submitted to the OWNER by the CONTRACTOR/Subcontractors and that such are reviewed for compliance with Wage and Labor Standard Provisions.
- b. Apprentices/trainees working on the Project are properly identified by CONTRACTOR/Subcontractor on payroll records and documented as being included in programs currently sanctioned by appropriate federal or Texas regulatory agencies.
- c. Applicable Wage Determination Decisions, including any applicable modifications, and related statements are posted at the Project Work site by the CONTRACTOR and that proper job classifications and commensurate minimum hourly base and any applicable fringe wage rates are paid.
- d. Employees are periodically interviewed (at random) on each Project as required.
- e. That no person employed by CONTRACTOR/Subcontractor is induced against his will, by any means, to give up any part of the compensation to which he is otherwise entitled.
- f. That any and all periodic administrative directives to the Wage & Hour Monitor (TITLE) from the OWNER's Finance Department and Board of Trustees are being implemented.

3. <u>CLAIMS & DISPUTES PERTAINING TO WAGE RATES</u>

Claims and disputes promptly and routinely settled bv the not CONTRACTOR/Subcontractor and employees pertaining to wage rates, or to job classifications of labor employed upon the Work covered by this Contract, shall be reported by the employee in writing, within sixty (60) Calendar Days of employee's receipt of any allegedly incorrect classification, wage or benefit report, to the Wage & Hour Monitor for further investigation. Claims and disputes not reported by the employee to the Wage & Hour Monitor in writing within the sixty (60) Calendar Day period shall be deemed waived by the employee for the purposes of the OWNER administering and enforcing the OWNER's Contract rights against the CONTRACTOR on behalf of the employee. Waiver by the employee of this OWNER intervention shall not constitute waiver by the OWNER or employee to independently pursue contractual rights it has against the CONTRACTOR/Subcontractor for breach of Contract and other sanctions available to enforce the Wage and Labor Standard Provisions.

4. BREACH OF WAGE AND LABOR STANDARD PROVISIONS

The OWNER reserves the right to terminate this Contract for cause if the CONTRACTOR/Subcontractors shall knowingly and continuously breach, without timely restitution or cure, any of these governing Wage and Labor Standard Provisions. A knowing and unremedied proven violation of these Wage and Labor Standard Provisions may also be grounds for a "non-responsibility" determination by OWNER thereby jeopardizing CONTRACTOR/Subcontractor from future OWNER contracts for lack of responsibility to perform future work, as determined by the OWNER. Recurrent violations, whether remedied or not, will be considered by the OWNER when assessing the responsibility history of a potential contractor/subcontractor prior to competitive award of future OWNER Public Works projects. The general OWNER remedies stated in this paragraph 4. above, are not exhaustive and not cumulative, for the OWNER reserves legal and contractual rights to other specific remedies outlined herein below and in other parts of this Contract and as are allowed by applicable OWNER resolutions, Texas and federal statutes.

5. <u>EMPLOYMENT OF LABORERS/MECHANICS NOT LISTED IN WAGE</u> <u>DETERMINATION DECISION</u>

In the event the CONTRACTOR/Subcontractor discovers that construction of a particular Work element requires a certain employee classification and skill that is <u>not</u> listed in the wage determination decision contained in the original Contract Documents, CONTRACTOR/Subcontractors will make prompt inquiry (at least twenty-one (21) Calendar Days before bidding, if possible) to the OWNER identifying that class of laborers/mechanics <u>not</u> listed in the current pre-bid wage determination decision who are intended to be employed, or who are being employed, under the Contract. Using his best judgment and information resources available to him at the time, and any similar, prior OWNER or Federal Department of Labor decisions, the Wage & Hour Monitor, shall

classify said laborers/mechanics by issuing a special local wage determination decision to the bidders or CONTRACTOR/Subcontractor, which shall be enforced by the OWNER.

6. <u>MINIMUM WAGE</u>

All laborers/mechanics employed to construct the Work governed by this Contract shall be paid not less than weekly the full amount of wages due (minimum hourly base pay and any applicable minimum hourly fringe benefit contribution for all hours worked, including overtime) for the immediately preceding pay period, computed at wage and fringe rates not less than those contained in the wage determination decision included in this Contract. Only payroll deductions as are mandated by Texas or federal law, and those legal deductions previously approved in writing by the employee, or as are otherwise permitted by Texas or federal law, may be withheld by the CONTRACTOR/Subcontractor.

Should the CONTRACTOR/Subcontractor subscribe to fringe benefit programs for employees, such programs shall be fully approved by the OWNER in adopting a previous U.S. Department of Labor decision on such fringe benefit programs or by applying DOL criteria, in rendering a local decision on the adequacy of the fringe benefit programs. The approved programs shall be in place at the time of OWNER's Contract execution and the provisions thereof shall be disclosed to the CONTRACTOR, for legal review prior to Project commencement, if a written request for same is submitted by CONTRACTOR/Subcontractor prior to CONTACTOR's execution of the Construction Agreement.

Regular CONTRACTOR/Subcontractor contributions made to, or costs incurred for, approved fringe benefit plans, funds or other benefit programs that cover periods of time greater than the one week payroll period (e.g. monthly or quarterly, etc.) shall be prorated by the CONTRACTOR/Subcontractor on weekly CONTRACTOR payroll records to reflect the equivalent value of the hourly and weekly summary of fringe benefits per employee.

7. OVERTIME COMPENSATION ON NON-FEDERALLY FUNDED PROJECTS

No CONTRACTOR/Subcontractor contracting for any part of the non-federally funded Contract Work (except for Project site related security guard services), which may require or involve the employment of laborers/mechanics, shall require or permit any laborer/mechanic in any seven (7) Calendar Day Work period in which he, she is employed on such Work, to Work in excess of forty (40) hours in such Work period, unless said laborer/mechanic receives compensation at a rate not less than one and one-half (1 $\frac{1}{2}$) times the basic hourly rate of pay for all hours worked in excess of forty (40) hours in a seven (7) Calendar Day Work period. Any applicable fringe benefits must be paid for straight time and overtime; however, fringe benefits are not included when computing the overtime rate.
8. <u>PAYMENT OF CASH EQUIVALENT FRINGE BENEFITS</u>

The CONTRACTOR/Subcontractor is allowed to pay a minimum hourly <u>cash equivalent</u> of any applicable minimum hourly <u>fringe</u> benefits listed in the wage determination decision, in lieu of the contribution of benefits to a permissible fringe benefit plan, for all hours worked, including overtime, as described in paragraphs 6. and 7. above. An employee is not allowed to receive less than the minimum hourly basic rate of pay specified in the applicable wage determination decision.

9. WORK CONDUCTED ON HOLIDAYS-NON-FEDERALLY FUNDED PROJECTS

If a laborer/mechanic is employed in the normal course and scope of his or her Work on the jobsite on New Year's Day, Martin Luther King Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or any additional local OWNER holidays specified by the OWNER in the Contract Documents or the Calendar Days observed as such in any given year, Work shall be paid for at no less than one and one-half (1 1/2) times the regular minimum hourly base pay regardless of the total number of hours the laborer/mechanic has accumulated during the pay period.

10. <u>UNDERPAYMENT OF WAGES OR SALARIES</u>

- When a "full investigation" (as called for in and as construed under Article 5159a, a. Sec. 2 and as may be further generally described in any administrative directive to the Wage & Hour Monitor from the OWNER), evidences underpayment of wages by CONTRACTOR/Subcontractor to laborers/mechanics employed upon the Work covered by this Contract, the OWNER, in addition to such other rights as may be afforded it under Texas and/or federal law and/or this Contract, shall withhold from the CONTRACTOR, out of any payments (interim progress and/or final) due the CONTRACTOR, so much thereof as the OWNER may consider necessary to secure ultimate payment by the appropriate entity to such laborers/mechanics, of full wages required by this Contract, plus possible penalty (See b. below). The amount so withheld, excluding any possible penalty to be retained by the OWNER, may be disbursed at an appropriate time after "full investigation" by the Wage & Hour Monitor, for and on behalf of the CONTRACTOR/Subcontractor (as may be appropriate), to the respective laborers/mechanics to whom the same is due, or on their behalf to fringe benefit plans, funds, or programs for any type of minimum fringe benefits prescribed in the applicable wage determination decision.
- b. Article 5159a, Revised Civil Statutes of Texas, as amended, states that the CONTRACTOR shall forfeit as a penalty to the OWNER the sum of sixty dollars (\$60.00) for each Calendar Day, or portion thereof, for each laborer, workman, or mechanic, who is paid less than the said stipulated rate for any Work done under this Contract, whether by the CONTRACTOR himself, or by any Subcontractor working under him. Pursuant to and supplemental to this statutory authority, the OWNER and the CONTRACTOR/Subcontractor contractually acknowledge and agree that said sixty dollar (\$60.00) statutory penalty shall apply to any violations

of paragraphs 6,7, or 9 herein, resulting from CONTRACTOR/Subcontractor underpayment violations.

unpaid workers located by the c. If or underpaid cannot be CONTRACTOR/Subcontractor or the OWNER after diligent efforts to accomplish same, unpaid or underpaid wages shall be reserved by the OWNER in a special "unfound worker's account" established by the OWNER, for such CONTRACTOR/Subcontractor employees. If after one (1) year from the final acceptance of the Project by the OWNER, workers still cannot be located, in order that the OWNER can make effective interim re-use of the penalty money, such wages and any associated statutory penalties may be used to defray actual costs incurred by the OWNER in attempting to locate said workers, and any remaining monies may then revert back to the OWNER's original funding source for the Project. However, unpaid or underpaid workers for which money was originally reserved are eligible to claim recovery from the OWNER for a period of not-toexceed three (3) years from the final acceptance of the Project by the OWNER. Claimant recovery after expiration of the three (3) year period is prohibited.

11. <u>DISPLAYING WAGE DETERMINATION DECISIONS/AND NOTICE TO</u> <u>LABORERS/MECHANICS STATEMENT</u>

The applicable wage determination decision(s) as described at the end of this Supplementary Conditions Section 1 (and as specifically included in each project contract), outlining the various worker classifications and mandatory minimum wages and minimum hourly fringe benefit deductions, if any, of laborers/mechanics employed and to be employed upon the Work covered by this CONTRACT, shall be displayed by the CONTRACTOR/Subcontractor at the site of Work in a conspicuous and prominent public place, readily and routinely accessible to workmen for the duration of the Project. In addition, the CONTRACTOR/Subcontractor agrees with the contents of the following statement, and shall display same, in <u>English and Spanish</u>, near the display of the wage determination decision at the Project site of Work:

NOTICE TO LABORERS/MECHANICS

Both the Brownsville Public Utilities Board and the CONTRACTOR/Subcontractor agree that you must be compensated with not less than the minimum hourly base pay and any required minimum hourly fringe benefit contribution in accordance with the wage rates publicly posted at this jobsite, and as are applicable to the classification of Work you perform.

Additionally, you must be paid not less than one and one-half times (1 ¹/₂) your basic hourly rate of pay for any hours worked over 40 in any seven (7) Calendar Day Work period, and for any Work conducted on New Year's Day, Martin Luther King Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, and Christmas Day and other possible locally observed holiday(s), or the Calendar Days observed as such in any given year.

Apprentice and trainee hourly wage rates and ratios apply <u>only</u> to apprentices and trainees recognized under approved Federal, or State, apprenticeship training programs registered with the Bureau of Apprenticeship and Training, U.S. Dept. of Labor.

If you believe that your employer is not paying the posted minimum wage for the type of Work you do, you must make direct inquiry to your employer and also inquire in writing, within sixty (60) Calendar Days of your receipt of any allegedly incorrect wage or benefit check or report, to the BPUB Wage & Hour Monitor. It is mandatory that you promptly file written inquiry of any allegedly incorrect wage or benefit checks or reports with the BPUB's Wage & Hour Monitor within the sixty (60) Calendar Day period, so that you do not waive your potential right of recovery under the provisions of the BPUB's construction Contract that governs this Project.

Both the BPUB and the CONTRACTOR/Subcontractor agree that no laborer/mechanic who files a complaint or inquiry concerning alleged underpayment of wages or benefits, shall be discharged by the employer, or in any other manner be discriminated against by the employer, for filing such complaint or inquiry.

12. <u>PAYROLLS & BASIC PAYROLL RECORDS</u>

- a. The CONTRACTOR and each Subcontractor shall prepare payroll reports in accordance with the "General Guideline" instructions furnished by the OWNER of the Project. Such payroll submittals shall contain the name and address of each such employee, his correct labor classification, rate of pay, daily and weekly number of hours worked, any deductions made, and actual basic hourly and fringe benefits paid. The CONTRACTOR shall submit payroll records each week, and no later than seven (7) working days following completion of the workweek being processed, to the OWNER. These payroll records shall include certified copies of all payrolls of the CONTRACTOR and of his Subcontractors, it being understood that the CONTRACTOR shall be responsible for the submission and general mathematical accuracy of payrolls from all of his Subcontractors. Each such payroll submittal shall be on forms deemed satisfactory to the Wage & Hour Monitor and shall contain a "Weekly Statement of Compliance", as called for by the Contract Documents. Such payrolls will be forwarded to the Wage & Hour Monitor.
- b. Copies of payroll submittals and basic supporting payroll records of the CONTRACTOR/Subcontractors accounting for all laborers/mechanics employed under the Work covered by this Contract, shall be maintained by CONTRACTOR/Subcontractor during the course of the Work, and preserved for a period of three (3) years after completion of the Project. The CONTRACTORS/Subcontractors shall maintain records which demonstrate: any contractor commitment to provide fringe benefits to employees as may be mandated by the applicable wage determination decision; that the plan or program is adjudged financially responsible by the appropriate approving authority, (i.e. U.S. Department of Labor, U.S. Department of Treasury, etc.); and that the provisions, policies, certificates, and description of benefits of the plan or program as may be periodically amended, have been clearly communicated in a timely manner and in writing, to the laborers/mechanics affected, prior to their performing Work on the Project.

c. The CONTRACTOR/Subcontractor shall make the above records available for inspection, copying, or transcribing by the Wage & Hour Monitor of the OWNER at reasonable times and locations for purposes of monitoring compliance with this Contract.

13. <u>LABOR DISPUTES</u>

The CONTRACTOR/Subcontractor shall immediately notify the Wage & Hour Monitor designated representative of anv actual impending his or or CONTRACTOR/Subcontractor labor dispute which may affect, or is affecting, the Project Performance Schedule of the CONTRACTOR's or any Subcontractor's Work. In addition, the CONTRACTOR/Subcontractor shall consider all appropriate measures to eliminate or minimize the effect of such labor disputes on the Project Progress Schedule, including but not limited to such measures as: promptly seeking injunctive relief if appropriate; seeking appropriate legal or equitable actions or remedies; taking such measures as establishing a reserved gate, as appropriate; if reasonably feasible, seeking other sources of supply or service; and any other measures that may be appropriately utilized to mitigate or eliminate the adverse Project jobsite and scheduling effects of the labor dispute.

14. <u>COMPLAINTS, PROCEEDINGS, OR TESTIMONY BY EMPLOYEES</u>

No laborers/mechanics to whom the wage, salary, or other labor standard provisions of this Contract are applicable shall be discharged, or in any other manner discriminated against by the CONTRACTOR/Subcontractors, because such employee has filed any formal inquiry or complaint, or instituted or caused to be instituted, any legal or equitable proceeding, or has testified, or is about to testify, in any such proceeding under or relating to the wage and labor standards applicable under this Contact.

15. <u>EMPLOYEE INTERVIEWS TO ASSURE WAGE AND LABOR STANDARD</u> <u>COMPLIANCE</u>

CONTRACTOR/Subcontractors shall allow expeditious jobsite entry of the Wage & Hour Monitor displaying and presenting proper OWNER identification credentials to the jobsite superintendent or his representative. While on the jobsite, the Wage & Hour Monitor shall observe all CONTRACTOR jobsite rules and regulations concerning safety, internal security and fire prevention. CONTRACTOR/Subcontractors shall allow Project employees to be separately and confidentially interviewed at random for a reasonable duration of time by the Wage & Hour Monitor to facilitate compliance determinations regarding adherence by the CONTRACTOR/Subcontractor to these Wage and Labor Standard Provisions.

16. <u>"ANTI-KICKBACK" PROVISION</u>

No person employed in the construction or repair of any OWNER public works Project shall be induced, by any means, to give up to any CONTRACTOR/Subcontractor or public

official or employee, any part of the hourly and/or fringe benefit compensation to which he or she is otherwise entitled.

17. <u>"FALSE OR DECEPTIVE INFORMATION" PROVISION</u>

Any person employed by the CONTRACTOR/Subcontractor in the construction or repair of any OWNER public works Project, who is proven to have knowingly and willfully falsified, concealed or covered up by any deceptive trick, scheme, or device a material fact, or made any false, fictitious or fraudulent statement or representation, or made or used any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be permanently removed from the Project jobsite by the CONTRACTOR/Subcontractor. The OWNER reserves the right to terminate this Contract for cause as a result of serious and uncured violations of this provision.

18. <u>EMPLOYMENT OF APPRENTICES/TRAINEES</u>

- Apprentices will be permitted to work at less than the predetermined rate for the Work they a. perform when they are employed and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship & Training, or with a Texas Apprenticeship Agency recognized by the Bureau, or if a person is employed in his first ninety (90) Calendar Days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship & Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen in any craft classification shall not be greater than the ratio under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not a trainee as defined in (b) below, or is not registered or otherwise employed as stated above, shall be paid the wage rate for the classification of Work he actually performs. The CONTRACTOR/Subcontractor is required to furnish to the Wage & Hour Monitor of the OWNER, a copy of the certification, along with the payroll record that the employee is first listed on. The wage rate paid apprentices shall be not less than the specified rate in the registered program for the apprentice's level of progress expressed as the appropriate percentage of the journeyman's rate contained in the applicable wage determination decision.
- b. Trainees will be permitted to work at less than the predetermined rate for the Work performed when they are employed pursuant to an individually registered program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen shall not be greater than that permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for his/her level of progress. Any employee listed on the payroll at a trainee wage rate, who is <u>not</u> registered and participating in a training plan approved by the Employment and Training Administration, shall be paid not less than the wage rate determined by the classification of Work he actually performs. The

CONTRACTOR/Subcontractor is required to furnish a copy of the trainee program certification, registration of employee-trainees, ratios and wage rates prescribed in the program, along with the payroll record that the employee is first listed on, to the Wage & Hour Monitor of the OWNER. In the event the Employment and Training Administration withdraws approval of a training program, the CONTRACTOR/Subcontractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the Work performed until an acceptable program is approved by the Employment and Training Administration.

c. Paragraphs 18.a. and b. above shall not operate to exclude training programs approved by the OFCCP, United States Department of Labor and as adopted by the Associated General Contractors (AGC) of Texas, Highway, Heavy, Utilities and Industrial Branch. Guidelines for these training programs shall be the same as those established for federally funded projects. This sub-paragraph 15.c. shall not apply to those portions of a project deemed to be building construction.

d. **<u>RATIOS, APPRENTICE TO JOURNEYMAN</u>**:

The Ratio of Apprentice to Journeyman for this Project shall be the same as the Ratio permitted under the plan approved by the Employment and Training Administration, Bureau of Apprenticeship and Training, U.S. Department of Labor, by craft. A copy of the allowable Ratios is included with the applicable Wage Determination Decision at the end of this Supplementary Conditions Section 1.

When a "full investigation" (as called for in, and as construed under Article 5159a, Sec. 2), evidences a violation of the Apprentice or Trainee to Journeyman ratios effective for CONTRACTOR/Subcontractor employees working on this Contract, the OWNER, in addition to such other rights as may be afforded it under Texas and/or federal law and/or other sections of this Contract (especially paragraph 10 Underpayment of Wages), shall withhold from the CONTRACTOR, out of any payments (interim progress and/or final) due the CONTRACTOR, the liquidated damages (not a penalty) sum of seventy-five dollars (\$75.00) for each Calendar Day, or portion thereof, for each certified Apprentice or Trainee employee assigned to a Journeyman that exceeds the maximum allowable Apprentice/Trainee to Journeyman ratio stipulated for any Work done under this Contract, whether by the CONTRACTOR himself, or by any Subcontractor working under him.

19. JOBSITE CONDITIONS

CONTRACTORS/Subcontractors will not allow any person employed for the Project to work in surroundings or under construction conditions which are unsanitary, unhealthy, hazardous, or dangerous as governed by industry standards and appropriate local, Texas and federal statutes, ordinances, and regulatory guidelines.

20. <u>EMPLOYMENT OF CERTAIN PERSONS PROHIBITED</u>

- a. The CONTRACTOR/Subcontractor shall knowingly only employ persons of appropriate ages commensurate with the degree of required skill, strength, maturity and judgment associated with the activity to be engaged in, but not less than the age of fourteen (14) years, as governed by Chapter 51 "Employment of Children", Texas Labor Code, (Vernon's Texas Codes Annotated) (as may be amended), and Texas Department of Labor and Standards rulings and interpretations associated with that statute. It is hereby noted that in some circumstances generally governed by this paragraph, a federal statute (see: Fair Labor Standards Act, 29 USCS Section 212; Volume 6A of the Bureau of National Affairs Wage Hour Manual at Paragraph 96:1; "Child Labor Requirements in Nonagricultural Occupations" WH Publication 1330, July 1978 as may be amended), could pre-empt the Texas Statute and therefore be the controlling law on this subject. The CONTRACTOR/Subcontractor should seek clarification from Texas and federal agencies and legal counsel when hiring adolescent employees for particular job classifications.
- b. Prohibited persons not to be employed are also those persons who, at the time of employment for this Contract, are serving sentence in a penal or correctional institution, except that prior approval by the Wage & Hour Monitor is required to employ any person participating in a supervised work release or furlough program that is sanctioned by appropriate Texas or federal correctional agencies.
- c. The CONTRACTOR/Subcontractors shall be responsible for compliance with the provisions of the "Immigration Reform and Control Act of 1986" Public Law 99-603, and any related Texas enabling or implementing statutes, especially as they apply in combination to the unlawful employment of aliens and unfair immigration-related employment practices affecting this Contract.

21. <u>PROVISIONS TO BE INCLUDED IN SUBCONTRACTS</u>

The CONTRACTOR shall cause these Wage and Labor Standard Provisions, or reasonably similar contextual adaptations hereof, and any other appropriate Texas and federal labor provisions, to be inserted (or referenced by "flow down" provisions) in all subcontracts relative to the Work to bind Subcontractors (and any sub-tier subcontractors) to the same Wage and Labor Standards as contained in these Supplementary Conditions and other Contract Documents insofar as applicable to the Work of Subcontractors or sub-tier subcontractors, and to give the CONTRACTOR similar, if not greater, general contractual authority over the Subcontractor, or sub-tier subcontractors, as the OWNER may exercise over the CONTRACTOR.

General Decision Number: TX20220003 01/07/2022 Superseded General Decision Number: TX20210003 State: Texas Construction Types: Heavy and Highway Counties: Cameron, Hidalgo and Webb Counties in Texas.

HEAVY & HIGHWAY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022, Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022, Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least \$11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2022.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at www.dol.gov/whd/govcontracts.

Modification Number Publication Date 0 01/07/2022

* SUTX2011-003 08/02/2011

Rates Fringes

CEMENT MASON/CONCRETE FINISHER (Paving & Structures)...\$ 12.46

FORM BUILDER/FORM SETTER (Structures).....\$ 12.30

Brownsville Public Utilities Board Supplementary Conditions #270413v2; 002/114 FORM SETTER (Paving & Curb)....\$ 12.16

LABORER

Asphalt Raker	\$ 10.61
Flagger	\$ 9.10
Laborer, Common	\$ 9.86
Laborer, Utility	\$ 11.53
Pipelayer	\$ 11.87
Work Zone Barricade	
Servicer	\$ 12.88

POWER EQUIPMENT OPERATOR:

Asphalt Distributor\$ 13.48
Asphalt Paving Machine\$ 12.25
Broom or Sweeper\$ 10.33
Crane, Lattice Boom 80
Tons or Less\$ 14.39
Crawler Tractor\$ 16.63
Excavator, 50,000 lbs or less\$ 12.56
Excavator, over 50,000 lbs\$ 15.23
Foundation Drill, Truck
Mounted\$ 16.86
Front End Loader Operator,
Over 3 CY\$ 13.69
Front End Loader, 3 CY or
less\$ 13.49
Loader/Backhoe\$ 12.77
Mechanic\$ 15.47
Milling Machine\$ 14.64
Motor Grader Operator,
Rough\$ 14.62
Motor Grader, Fine Grade\$ 16.52
Scraper\$ 11.07
-
Servicer\$ 12.34
Steel Worker (Reinforcing)\$ 14.07
·
TRUCK DRIVER
Lowboy-Float\$ 13.63
Single Axle\$ 10.82
Single or Tandem Axle Dump\$ 14.53
Tandem Axle Tractor with
Semi Trailer\$ 12.12
WELDER\$ 14.02
Brownsville Public Utilities Board

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union, which prevailed in the survey for this classification, which in this example would be Plumbers 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year

of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Division National Office Branch of Wage Surveys. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations Wage and Hour Division U.S. Department of Labor 200 Constitution Avenue, N.W. Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator

U.S. Department of Labor 200 Constitution Avenue, N.W. Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board U.S. Department of Labor 200 Constitution Avenue, N.W. Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

PART II – TECHNICAL SPECIFICATIONS

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SCOPE SUMMARY

- A. Furnish all labor, materials, equipment, and incidentals required to rehabilitate or reconstruct four (4) wastewater lift stations and associated sitework as shown on the drawings, and as specified herein.
- B. Furnish all labor, materials, equipment, and incidentals required to rehabilitate or reconstruct the electrical systems for four (4) wastewater lift stations as shown on the drawings in accordance with governing regulations, and as specified herein.
- 1.02 LOCATION OF WORK
 - A. The Lift Station Rehabilitation project is located at various locations in Cameron County inside the City of Brownsville.
- 1.03 WORK COVERED BY CONTRACT DOCUMENTS
 - A. The Work includes but is not limited to the following:
 - 1. Lift Station 9
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pumps, rails, level sensors, and piping.
 - (iii) Replace force main, valves, and appurtenances.
 - b. Remove/replace electrical
 - c. Construct new electrical building
 - d. Sitework rehabilitation
 - 2. Lift Station 10
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pumps, rails, level sensors, and piping.
 - (iii) Replace force main, valves, and appurtenances.
 - b. Remove/replace electrical
 - c. Sitework rehabilitation
 - 3. Lift Station 11
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pump rails, level sensors, and piping.
 - (iii) Replace force main, valves, and appurtenances.
 - b. Remove/replace electrical
 - c. Sitework rehabilitation
 - 4. Lift Station 43
 - a. Rehabilitate wet well
 - (i) Re-coat interior wet well walls.
 - (ii) Replace pump rails, level sensors, and piping.

- (iii) Replace force main, valves, and appurtenances.
- b. Remove/replace electrical
- c. Sitework rehabilitation
- B. Structural, mechanical, and/or electrical changes caused by Contractor's selection of equipment with dimensional, power, or mechanical differences from field conditions shall be made by the Contractor at no additional cost to OWNER. All engineering costs associated with the revisions shall also be borne by the Supplier.
- C. Any damage to the existing equipment, structures or items to remain during construction shall be fully repaired to OWNER's satisfaction.
- D. All work done under this contract shall conform to all local ordinances. Contractor shall arrange and pay all cost of permits and inspection fees not already obtained by the OWNER, and shall confine his operation to the limits set by law.
- E. It is the intent of the OWNER to award this project to one Contractor.
- 1.04 WORK OF OTHER CONTRACTS
 - A. During the Work of this Contract, it is not anticipated that construction by other contractors for separate but related work will be in progress at the Site. Should any additional Work be done at this site, the CONTRACTOR should coordinate any additional work by others necessary at no additional cost to the OWNER.
- 1.05 EXISTING CONDITIONS
 - A. Locate and protect all existing utilities impacted by this project. Those affected by this project may include, but are not necessarily limited to:
 - 1. Brownsville Public Utilities Board
 - 2. AEP Energy
 - 3. AT&T
 - 4. Time-Warner Cable
 - 5. MCI, Sprint
 - 6. 1-800-DIG-TESS (utility locate services)
 - 7. Texas One-Call (utility locate services)
 - 8. Lonestar One-Call (utility locate services)
- 1.06 WORK SEQUENCE
 - A. The Contractor shall furnish, install and place into operation the wastewater lift stations, sitework, and electrical systems within 26 weeks (180 calendar days) from Notice to Proceed on the project.
 - B. Construct work in stages to provide proper coordination with work by Others. Coordinate the construction schedule and operations with the OWNER's representative. Refer to General Conditions and Section 01015 – Sequence of Construction for milestone completion requirements.
 - C. Traffic Control plan conforming to the requirements of the Texas Manual on Uniform Traffic Control Devices shall be provided by the CONTRACTOR to the governing R.O.W. agency and the OWNER when the proposed construction affects, or is located

within the limits, or R.O.W. of a local, or, state or federal maintained R.O.W. The CONTRACTOR shall not begin construction of the Project or close any streets until the traffic control plan has been approved by the governing R.O.W. agency, the OWNER and all traffic control devices are properly installed and maintained at the job site in accordance with the Texas Manual on Uniform Traffic Control Devices. The CONTRACTOR shall notify the governing R.O.W agency and the OWNER forty-eight (48) hours in advance of closing any street to through traffic. CONTRACTOR shall provide for the access of residents and businesses within all phases of work. This may include, but not limited to, providing steel plates as temporary trench crossings at entrances to businesses or residences. Flagmen to control traffic at these crossings shall be used as necessary.

D. The CONTRACTOR shall prepare and submit a construction schedule that accomplishes the Work within the allotted time and adheres to the overall schedule and Project specific constraints listed herein.

1.07 CONTRACTOR'S USE OF PREMISES

- A. CONTRACTOR shall limit his use of the premises for Work and for storage. The following information must be displayed on the dashboard of every vehicle that enters BPUB property:
 - 1. Name of Project
 - 2. Name of Contractor
 - 3. Name of Employee
 - 4. Vehicle License Number
- B. Coordinate use of premises under direction of OWNER.
- C. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.
- D. Move any stored products, under CONTRACTOR's control, which interfere with operations of the OWNER or separate contractor.
- E. Obtain and pay for the use of additional storage or work areas needed for operations.
- 1.08 PROJECT REQUIREMENTS
 - A. "Or-Equal" products will be allowed if approved by the Owner and Engineer. Refer to General Conditions for requirements.
 - B. Preparation For Shipment. All materials shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of OWNER.
 - C. Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packaging lists and bills of materials shall be included with each shipment.

- D. Notices To OWNERs And Authorities. CONTRACTOR shall, as provided in the General Conditions, notify owners of adjacent property and utilities when prosecution of the Work may affect them.
 - 1. When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, CONTRACTOR shall give written notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and shall include appropriate information concerning the interruption and instructions on how to limit inconvenience cased thereby.
 - 2. Utilities and other concerned agencies shall be notified at least seventy-two (72) hours prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.
- E. Lines And Grades. All Work shall be done to the lines, grades, and elevations indicated on the Drawings.
 - CONTRACTOR shall provide an experienced instrument person, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, CONTRACTOR shall furnish, without charge, competent persons and such tools, stakes, and other materials as OWNER may required in establishing or designating control points or in checking survey, layout, and measurement work performed by CONTRACTOR.
 - 2. CONTRACTOR shall keep OWNER informed, a reasonable time in advance, of the times and places at which the CONTRACTOR wished to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by OWNER. So it may be done with minimum inconvenience to OWNER and minimum delay to CONTRACTOR.
 - 3. CONTRACTOR shall remove and reconstruct work which is improperly located.
- F. Connections to Existing Facilities. Unless otherwise specified or indicated, CONTRACTOR shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electric. In each case, CONTRACTOR shall receive permission from OWNER or the owning utility prior to undertaking connections. CONTRACTOR shall protect facilities against deleterious substances and damage. CONTRACTOR shall provide a minimum of seventy-two (72) hours notice prior to making interconnection.
 - 1. Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.
- G. Unfavorable Construction Conditions. During unfavorable weather, wet ground, or other unsuitable construction conditions, CONTRACTOR shall confine its operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by CONTRACTOR to perform the Work in a proper and satisfactory manner.

- H. Cleaning Up. CONTRACTOR shall keep the premises free at all times from accumulations of waste materials and rubbish. CONTRACTOR shall provide adequate trash receptacles about the site and shall promptly empty the containers when filled.
 - 1. Construction materials, such as concrete forms and scaffolding, shall be neatly stacked by CONTRACTOR when not in use. CONTRACTOR shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.
 - 2. Volatile wastes shall be properly stored in covered metal containers and removed daily.
 - 3. Wastes shall not be buried or burned on the site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the site and disposed of in a manner complying with local ordinances and antipollution laws.
 - 4. Adequate cleanup will be a condition for recommendation of progress payment applications.
- I. Applicable Codes. Reference in the Contract Documents to local codes mean the following:
 - 1. Other standard codes which apply to the Work are designated in the Specifications.
- J. Reference Standards. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated. However, no provision of any referenced standard, specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR, CONSULTANT, or ENGINEER, or any of their Consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to ENGINEER, or any of ENGINEER's Consultants, agents, or employees, any duty or authority to supervise or direct the furnishing or performance of the Work.
- K. Site Administration. CONTRACTOR shall be responsible for all areas of the site used by it and by all Subcontractors in the performance of the Work. CONTRACTOR will exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to OWNER or others. CONTRACTOR has the right to exclude from the site all persons who have no purpose related to the Work or its inspection and may require all persons on the site (except OWNER's employees) to observe the same regulations as CONTRACTOR requires of its employees.
- 1.09 SECURITY
 - A. The CONTRACTOR shall initiate a security program to protect the Work, CONTRACTOR's construction equipment and OWNER's facilities from theft, vandalism, and unauthorized entry for the duration of the construction period. Program shall be initiated at mobilization and shall be maintained throughout the construction

duration until final OWNER acceptance of the complete project. Refer to Section 01500 – Construction Facilities and Temporary Control for security requirements.

1.10 YARD MAINTENANCE

A. Site Yard Work. CONTRACTOR shall be responsible for maintaining the entire yard throughout the duration of the project. Refer to Section 01500 – Construction Facilities and Temporary Control for yard maintenance requirements.

END OF SECTION

SECTION 01015

SEQUENCE OF CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The construction of this project will occur while the lift stations are operating to meet specific, critical water supply requirements. The operations necessary to meet these requirements are of higher priority than construction activities. Schedules of by-pass pumping, connections, renovations and modifications shall be submitted to the OWNER for approval, and all such items shall be coordinated throughout the entire construction period. These schedules shall permit full and normal operation of the facility.
- B. CONTRACTOR shall prepare and submit a project schedule, schedule of values and safety plan within 10 days of Notice to Proceed.
- C. CONTRACTOR shall notify the OWNER in writing at least 14 days in advance and again three (3) days prior to beginning work on a particular area, and coordinate with the OWNER the specific items to be isolated and duration for each. Obtain written approval from the OWNER prior to each shutdown. Drought conditions, scheduling of improvements and shut-downs at other sites or equipment outages may require the rescheduling of an approved shutdown. Any cost associated with rescheduling will be considered as incidental to the CONTRACTOR's cost of the project.
- D. Prior to beginning work on shutdowns and process connections, CONTRACTOR shall have on-site all materials, equipment, and personnel necessary to complete the work in the time scheduled. CONTRACTOR shall also perform all preparatory tasks to the most complete state possible. For example, all exposed bolts and nuts on valves, flanges, or fittings which are to be disassembled shall be removed and replaced one at a time prior to shutdown and connections; thus allowing for as timely completion as possible.
- E. Failure of the CONTRACTOR to properly plan and perform the work in the prescribed manner may result in inadequate pumping of wastewater. In this case, CONTRACTOR may be liable for payment of fines, fees or other charges imposed upon the OWNER by state or federal regulatory agencies, and all other costs associated with the discharge. The OWNER may recover monetary sums by retention.
- F. Plugged pipelines, in which water has been standing, shall be cleaned of debris prior to conducting Work. All waterlines shall be disinfected as required by regulatory requirements prior to returning to service.
- G. CONTRACTOR shall be required to maintain the access roads utilized during construction in a reasonably clean condition. Weekly street cleaning and scraping will be required as directed by the OWNER.
- H. CONTRACTOR shall be required to perform yard maintenance services throughout the duration of the construction project, per Section 01010 Summary of Work and Section 01500 Construction Facilities and Temporary Controls.

- I. Access roads shall not be utilized for storage of materials.
- 1.02 RELATED WORK
 - A. Bid Proposal
 - B. Section 01300 Submittals
 - C. Section 01640 Contractor's Field Services
 - D. Section 01650 Facility Startup/Commissioning Requirements
- 1.03 SUBMITTALS
 - A. Project submittal specifications are detailed in Section 01300 Submittals.
 - B. The Drawings indicate the general location and arrangement of existing conditions. Prior to developing any construction drawings and/or Work Plans, it is mandatory that the Bidder visit the site to determine the complexity of the work and the existing conditions. Conditions which are obvious/visible, noted in the plans or which should be reasonably anticipated by the Bidder on inspection will not be considered as a "differing site conditions" clause of this Contract.
 - C. CONTRACTOR shall submit a plan to be reviewed and accepted by the OWNER for the sequence of construction and placement of facilities into operation in accordance with the provisions of Section 01650 Facility Startup and this section. The plan shall be submitted to the OWNER and accepted by the OWNER at least 30 days prior to initial startup of facilities. The plan shall include the specific items indicated in Part 3 of this section. CONTRACTOR may request modifications to the items in Part 3 which shall be subject to acceptance by the OWNER. The plan shall include the following:
 - 1. Organization charts detailing the Construction/Home Office organizational structure.
 - 2. A detailed staffing plan/curve for both field craft and staff.
 - 3. A proposed schedule for performance of the Work in the project-scheduling tool, Microsoft Project© or Primavera P3, with submittals of the original file and Adobe PDF.
 - 4. Names, resumes, professional registrations and certifications, schedule for assignment and signature authorities of Key Personnel. Provide guarantees that personnel named will in fact be those utilized in execution of the Work.
 - 5. A description of CONTRACTOR's proposed execution approach, addressing project management, interfacing with the sequence of work, equipment and materials salvage and staging, equipment required for bypass pumping, demolition, and construction activities.
 - 6. Demonstrate experience with municipal lift station shut-downs and start-ups and improvements to existing facilities.
 - 7. A detailed description of how the CONTRACTOR will install and maintain the sanitary sewer bypass while constructing the improvements to the existing system. The CONTRACTOR shall keep the existing gravity and force main system in service during construction.
 - 8. Demonstrate a firm understanding of the execution requirements.
 - 9. CONTRACTOR's plans for the removal and disposal of debris, trash, and waste. Plans shall include removal and disposal of asbestos concrete pipe.

- 10. A detailed list of activities that will be performed by SUBCONTRACTORs (to be included in detailed schedule).
- 11. Schedule for training of OWNER's personnel as discussed in Section 01640 Contractor Field Services.
- 1.04 CONTRACTOR'S RESPONSIBILITIES DURING SHUTDOWNS
 - A. CONTRACTOR's responsibility during any and all shutdowns is outlined below. A shutdown is defined as taking any process or piece of equipment out of service whether or not flows are diverted around any process.
 - 1. Supply of Equipment
 - a. CONTRACTOR shall be responsible for providing all equipment, labor, and materials for accomplishing the shutdown on schedule.
 - 2. Dewatering
 - CONTRACTOR shall be responsible for dewatering of any structures, a. pipelines and excavations necessary for completion of construction, including dewatering for all shutdowns. CONTRACTOR shall also be responsible for maintaining dewatering of the structure if necessary for completion of the work. CONTRACTOR shall also maintain watertight any dam or bulkhead, temporary or otherwise, if leakage from the dam or bulkhead will result in adverse impacts on the pump station's operation or require maintenance by OWNER personnel. CONTRACTOR shall be responsible for supplying all pumps, piping (temporary or otherwise), and any other items necessary for dewatering. Dewatering shall be defined as removal of all liquid, sludge, grit, and any other solids or liquids as necessary to accomplish construction. CONTRACTOR is cautioned that the existing facilities may contain significant quantities of grit and other solids that he is required to remove and dispose of off-site. In some instances, CONTRACTOR will be limited to the rate that he may transfer to disposal location or other process facilities.
 - B. Timely Completion
 - 1. CONTRACTOR shall be responsible for the manning and scheduling of all shutdowns to accomplish them in the time set forth. The responsibility includes coordination with all applicable utility companies, pump station staff, and other CONTRACTORs working onsite. If any overtime or shift work is required to accomplish the shutdown or diversion within the required time limits, the cost of such overtime of shift work shall be at the CONTRACTOR's sole expense.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. CONTRACTOR shall coordinate and schedule each task necessary to complete all work within the time allowed for the Project. Coordination and time limitations for individual facilities are described in following paragraphs. These phases are general in nature and not intended to prescribe the CONTRACTOR's Work Plan. Work items from various phases may be done simultaneously or separately unless otherwise specified.

B. Each phase may require the CONTRACTOR to perform work such as installing temporary or permanent piping, plugs/valves and/or diversion facilities in structures that are in service. The specifics related to flow diversion and temporary plugging means and methods are the responsibility of the CONTRACTOR; however, the CONTRACTOR's plans and schedules shall be submitted to the OWNER for review and approval.

3.02 PUMPING AND DEWATERING OPERATIONS

- A. Work to be performed may require draining, pumping and dewatering, and certain cleaning operations necessary to complete the work as specified and as indicated on the Drawings. It is the intent of these specifications that such draining, pumping and dewatering, and cleaning operations shall be the obligation of the CONTRACTOR.
- B. CONTRACTOR shall provide all necessary pumping as required to remove all surface water, groundwater, leakage, and water from other sources from excavations. Excess water from dewatering operations shall be disposed of in an area and a manner acceptable to the OWNER.
- C. CONTRACTOR shall provide all necessary pumping as required to fill and/or refill facilities for placement into operation.

3.03 WATER FOR CONSTRUCTION AND TESTING

If potable water is required for the CONTRACTOR's operations, arrangements may be Α. made with the OWNER. A suitable meter and valves, taps, fittings, piping and other appurtenances shall be provided by the CONTRACTOR. The OWNER will provide water to CONTRACTOR at no charge during construction. CONTRACTOR shall pay the OWNER a refundable deposit for water use. CONTRACTOR shall take adequate precautions to protect the OWNER's lines from contamination or damage. If the CONTRACTOR desires to utilize OWNER water at fire hydrants, then he shall install at his expense, a slow closing valve on the outlet and a meter to be provided by the OWNER. When the CONTRACTOR is using water from the hydrant, he shall open the hydrant valve in the morning and use the valve which has been installed for control at all other times. At night, upon cessation of construction operations, the hydrant valve shall be closed. At all other times when the CONTRACTOR's valve remains on the outlet, the CONTRACTOR shall keep necessary wrenches available at the hydrant so that the valve can be quickly removed by the OWNER in case of fire. The OWNER will not allow use of existing fire hydrants unless the CONTRACTOR adheres to the above-described requirements. CONTRACTOR shall make necessary arrangements to convey the water from the source to the construction site at no additional cost to OWNER.

3.04 SEQUENCE OF CONSTRUCTION

A. Perform work in the suggested sequence listed below to accommodate OWNER's occupancy during the construction period and to ensure completion of the work in the Contract Time. CONTRACTOR is encouraged to review this sequence and develop a detailed sequence for discussion with OWNER prior to beginning construction. CONTRACTOR can submit an alternate construction sequence for OWNER's review and acceptance. Some construction activities may be conducted concurrently. Some construction activities may require temporary bulkheads and the use of existing valves. CONTRACTOR shall anticipate that everything existing is not in working order and

leaks. CONTRACTOR is responsible for providing temporary bulkheads, plugs, pumps, valves and other equipment, as required, at no additional cost to the OWNER. CONTRACTOR shall plan for the use of temporary plugs and pumping for installation of and leakage from the temporary bulkheads. Completion dates of the various stages shall be in accordance with the accepted construction schedule submitted by the CONTRACTOR.

- B. Required CONTRACTOR Completion Dates:
 - 1. The Work specified herein and any other Contract Work required by the OWNER which may interrupt the normal operations of the lift stations shall be accomplished at such times that will be convenient to the OWNER. The CONTRACTOR shall plan to Work overtime if needed to complete construction of the various Project improvements and shall make no claims for extra compensation for overtime Work required to conform to these requirements. The CONTRACTOR shall coordinate with the OWNER in accordance with Paragraph 1.01.C of this Section prior to performing Work associated with temporary equipment shut-downs.

THE EXISTING SANITARY SEWER SYSTEM SHALL REMAIN OPERATIONAL DURING COMPLETION OF ALL WORK EXCEPT DURING THE TIME OF TIE-IN OF THE NEW CONSTRUCTION WITH THE EXISTING WATER PIPING. CONTRACTOR SHALL COORDINATE ALL SHUTDOWN TIME WITH BPUB. CONTRACTOR SHALL KEEP THE DURATION OF SHUTDOWN TIME TO A MINIMUM REQUIRED TO COMPLETE TIE-IN WORK.

- 2. Construction Sequencing:
 - a. Contractor shall furnish and install all tools and material required to rehabilitate the existing or construct a new lift station in accordance with the plans and specifications.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

CONTRACTOR shall provide necessary engineering services required for construction of the Project. Such Work shall include Work to locate and lay out all improvements, structures, and controlling lines for the Work. Also included are such services as are specified or required to execute CONTRACTOR's construction methods.

1.02 QUALITY CONTROL

- A. Conform to State of Texas laws for surveying requiring licensed surveyors. All survey work will be performed under supervision of a Texas Registered Professional Land Surveyor (RPLS).
- B. CONTRACTOR shall employ and retain at the site of the Work a Field ENGINEER, capable of performing all engineering tasks required of the CONTRACTOR.
- 1.03 SUBMITTALS
 - A. Daily reports of Project activity shall be submitted by the CONTRACTOR to the OWNER with all pertinent information pertaining to the Project as follows:
 - 1. Numbers of employees.
 - 2. Subcontractor employees.
 - 3. Breakdown of employees by trade.
 - 4. Major equipment and materials installed.
 - 5. Major construction equipment utilized.
 - 6. Location of all areas in which construction was done.
 - 7. Materials and equipment received.
 - 8. Work performed.
 - B. Furnish, as indicated on contract documents, all required lines and grades for construction. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment. Make distances and measurements on horizontal lines, except elevations and structural dimensions.
 - C. Submit documentation verifying accuracy of survey work on request.
 - D. Submit certificate signed by surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.

1.04 SURVEY REQUIREMENTS

- A. Maintain field office files and drawings, record drawings, and coordinate engineering services with Subcontractors. Prepare layout and coordination drawings for construction operations.
- B. Check and coordinate Work for conflicts and interferences and immediately advise OWNER of all discrepancies noted.

- C. Cooperate with OWNER in field inspections as required.
- D. The CONTRACTOR shall safeguard all permanent benchmarks at the site and shall bear the cost of replacing the benchmarks and assume entire expense of correcting Work improperly constructed due to failure to maintain and protect such established points and marks.

1.05 REFERENCE POINT PRESERVATION

- A. CONTRACTOR shall set monuments for principal control points and protect them from being disturbed and displaced.
 - 1. Re-establish disturbed monuments.
 - 2. When disturbed, postpone parts of the Work that are governed by disturbed monuments until such monuments are re-established.

1.06 EXAMINATION

- A. Verify locations of survey control points prior to starting Work.
- B. Notify ENGINEER immediately of any discrepancies discovered.
- 1.07 RECORD DOCUMENTS
 - A. Maintain a complete and accurate log of control and survey work as it progresses.
 - B. Prepare and submit Project record documents as specified in Section 01720 Project Record Documents.
 - C. Affix Civil Engineer's or land surveyor's signature and registration number to Record Drawing to certify accuracy of information shown.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01150

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section defines the method that will be used to determine the quantities of Work performed or materials supplied and establish the basis upon which payment will be made.

1.02 AUTHORITY

- A. Measurement methods delineated in Specification Sections are intended to complement the criteria of this section. In the event of conflict, the requirements of the Specification Section shall govern.
- 1.03 BID PROPOSAL
 - A. Required items of Work and incidentals necessary for the satisfactory completion of the Project shall be considered incidental to the specified Work required under this contract and shall be considered as included in the unit bids for the various bid items. The CONTRACTOR shall prepare his bid accordingly to allow for such items:
 - 1. Not specifically listed in the bid proposal form.
 - 2. Not specified in this section to be measured or to be included in one of the items listed in the bid proposal form.
 - 3. To include CONTRACTOR overhead and profit.
 - B. Work includes the furnishing of all labor, materials, equipment, tools, and related items for performing all operations required to complete the Project satisfactorily in place, as specified by the contract documents.
- 1.04 ADMINISTRATIVE SUBMITTALS
 - A. Schedule of Values: Submit schedule on CONTRACTOR standard form.
 - B. Schedule of Estimated Progress Payments:
 - 1. Submit with initially acceptable schedule of values.
 - 2. Submit adjustments thereto with Application for Payment.
 - C. Application for Payment.
 - D. Final Application for Payment.
- 1.05 SCHEDULE OF VALUES
 - A. Prepare a separate schedule of values for each schedule of Work under the Agreement.

- B. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
- C. An unbalanced or front-end loaded schedule will not be acceptable.
- D. Summation of the complete schedule of values representing all Work shall equal the Contract Price.
- 1.06 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS
 - A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.
 - B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.
- 1.07 APPLICATION FOR PAYMENT
 - A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of CONTRACTOR.
 - B. Provide separate form for each schedule as applicable.
 - C. Include accepted schedule of values for each schedule or portion of Work, the unit price breakdown for Work to be paid on unit price basis, a listing of OWNER-selected equipment, if applicable, and allowances, as appropriate.
 - D. Preparation:
 - 1. Round values to nearest dollar.
 - 2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form for each schedule as applicable.
 - 3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by OWNER.

1.08 MEASUREMENT – GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.
- B. Whenever pay quantities of material are determined by weight, the material shall be weighed on scales furnished by CONTRACTOR and certified accurate by the state agency responsible. A weight or load slip shall be obtained from the weigher and delivered to the OWNER's representative at the point of delivery of the material.

- C. If material is shipped by rail, the car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.
- D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by OWNER. Each vehicle shall bear a plainly legible identification mark.
- E. All materials which are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that the actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. All vehicles shall be loaded to at least their water level capacity. Loads hauled in vehicles not meeting the above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.
- F. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.
- G. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings.
- H. Units of measure shown on the Bid Form shall be as follows unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by BPUB Inspector
CY	Cubic Yard—Field Measure by BPUB Inspector within the
	limits specified or shown
CY-VM	Cubic Yard—Measured in the Vehicle by Volume
EA	Each—Field Count by BPUB Inspector
GAL	Gallon—Field Measure by BPUB Inspector
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by BPUB Inspector
LS	Lump Sum—Unit is one; no measurement will be made
SF	Square Foot SY Square Yard TON Ton—Weight Measure
	by Scale (2,000 pounds)

1.09 RELATED WORK

- A. Section 01300 Submittals
- B. Section 01370 Schedule of Values

1.10 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment shall not be made for the following:
 - 1. Loading, hauling and disposing of rejected material.

- 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
- 3. Rejected loads of material, including material rejected after it has been placed by reason of failure of CONTRACTOR to conform to provisions of Contract Documents.
- 4. Material not unloaded from transporting vehicle.
- 5. Defective Work not accepted by OWNER.
- 6. Material remaining on hand after completion of Work.
- 1.11 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT
 - A. Partial Payment: No partial payments shall be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to OWNER.
 - B. Final Payment: Shall be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to MANFUACTURER unless otherwise agreed, and partial payments made for those items shall be deducted from final payment.
- PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SCOPE SUMMARY

- A. Submittal procedures for:
 - 1. Schedule of Values.
 - 2. Construction Schedules.
 - 3. Shop Drawings, Product Data, and Sampler/Operations and Maintenance Data.
 - 4. CONTRACTOR's Certificates.
 - 5. Project Record Documents.
 - 6. Design Mixes.
- 1.02 DESCRIPTION OF WORK
 - A. This section describes the requirements and procedures for submitting shop drawings, product data, samples, other submittals relating to products, and as specified in individual sections.
- 1.03 DEFINITIONS
 - A. Product Data and Shop Drawing General Definition
 - 1. Drawings, diagrams, illustrations, brochures, schedules, bills of materials and other data prepared by the CONTRACTOR, his Subcontractors, suppliers or distributors, or CONTRACTORS and Fabricators; illustrating the manufacture, fabrication, construction, or installation of the Work or a portion thereof.
 - B. Shop Drawings
 - Diagrams, drawings, schedules, and other data prepared for illustration of a portion of the Work. Assembly and fabrication of drawings, bills of materials for items shop fabricated exclusively for this Project. In addition, shop drawings should show fabrication details of each part, the assembly of each part and how each part and/or assembly is integrated into the Project including existing parts or assemblies.
 - C. CONTRACTOR'S Representative
 - 1. A representative from the CONTRACTOR's plant with five (5) years of experience in the actual process of manufacturing, installing, and operating the particular product. Sales representatives or agents of the CONTRACTOR shall not be acceptable.
 - D. Working Drawings

1. CONTRACTOR-prepared plans for temporary structures and facilities. Working drawings for elements of Work that may affect the safety and health of persons or property shall be certified by an ENGINEER licensed in the state of Texas. Calculations, as necessary, shall accompany working drawings.

1.04 PROCEDURES

- A. Electronic Submittal Procedures
 - 1. All files by the CONTRACTOR shall be in Portable Document Format (PDF) as generated by Bluebeam Revu Version 20.0 or higher.
 - 2. It will be the CONTRACTOR's responsibility to scan all necessary documents or convert previously received electronic files from vendors into pdf format before uploading the files to the specific OWNER designated site. Scanned images must be at a readable resolution. For most documents, they should be scanned at 300 dots per inch (dpi). Optical character Recognition (OCR) capture must be performed on these images so that text can be searched and copied from the generated PDF file.
 - 3. Electronic submittals shall be added to the specific OWNER designated submittal register by the CONTRACTOR as follows:
 - a. Each class of material or equipment for which a submittal is required and for which a transmittal form has been generated shall be added by the CONTRACTOR as a separate submittal item in the register following the procedures indicated during the training session to be provided by the OWNER. One PDF document (PDF file) shall be created for each item. The entire set of documents (e.g., drawings, equipment catalog, cutsheets, schedules, etc.) associated with the submitted item shall be converted to a single .PDF file via scanning or other method of conversion. Drawings or other graphics shall be converted to PDF format and included into the single PDF documents. Pages that must viewed in landscape format shall be rotated to the appropriate position for easy reading on screen.
 - b. When multiple items are submitted at the same time, CONTRACTOR shall create a submittal package in the OWNER designated register and include the submitted items in this package following the procedures indicated during the training session to be provided by the OWNER. Each submittal package should be associated with a construction trade (e.g. structural steel). Separate submittal packages should be created for different trades.
 - 4. When making electronic submittals, the address for the submittal will always be the reviewer(s) designated by the OWNER. OWNER will access the materials as necessary through the respective OWNER designated location of the Portal web site.
 - 5. When it is not possible to make submittals electronically, CONTRACTOR may deliver submittals to OWNER using conventional mail only after securing OWNER's written approval. When electronic submittals are not possible, hard copy submissions will be made as required in this section. Submittal of a transmittal page into the contract-specific OWNER designated site of Portal by CONTRACTOR shall still be required for record keeping.
 - 6. As a courtesy, the OWNER will notify the CONTRACTOR of when the response to a submittal is available on OWNER designated site via electronic mail. However, it is the CONTRACTOR's responsibility to frequently monitor the submittal register

of the Project's site. All responses to a submittal by OWNER will be made electronically and no hard copies of the response will be sent to CONTRACTOR.

- 7. When electronic submittal is not possible and upon securing OWNER's written approval, CONTRACTOR may submit hard copies of product data and shop drawings according to the following distribution list:
 - a. OWNER's designated Agent (if applicable): 3 copies.
 - b. OWNER (if a designated Agent reviews the submittals): 1 copy
- 8. If regular mail delivery is approved by OWNER, the submittal transmittal form shall still be logged into the contract specific site of Portal by CONTRACTOR for record keeping purposes.
- 9. When electronic submittal protocols are employed, the OWNER will be responsible for placing all approved data into a designated file for reference by all interested parties.
- B. Transmittal Form and Numbering
 - 1. Transmit all Submittals electronically (PDF) to the OWNER's representative with Transmittal Form via email to the following:

BPUB 1425 Robinhood Drive Brownsville, TX 78521

Email:

- Sequentially number each transmittal form beginning with the number 1. Resubmittals shall use the original number with an alphabetic suffix (i.e., 2A for first re-submittal of Submittal 2 or 15C for third re-submittal of Submittal 15). Each submittal shall only contain <u>one type of work, material, or equipment</u>. <u>Mixed</u> <u>submittals will not be accepted</u>.
- 3. Identify variations from requirements of Contract Documents and identify product or system limitations.
- C. CONTRACTOR's Responsibilities
 - 1. Submit a schedule of specified submittals to the OWNER within fifteen (15) calendar days of receipt of the notice to proceed. The schedule of submittals should include entire list of submittals to be submitted and dates of planned submittals.
 - 2. Within thirty (30) days after the preconstruction conference and at the same time as the initial critical path schedule is submitted, a schedule shall be submitted of the items of materials and equipment for which shop drawings are required by the specifications. For each required shop drawing, the date shall be given for intended submission of the drawing to OWNER for review and the date required for its return to avoid delay in any activity beyond the scheduled start date. Sufficient time shall be allowed for initial review, correction and resubmission, and final review of all shop drawings. In no case shall the schedule be acceptable which allows less than thirty (30) days for each review by OWNER. This time for

review shall in no way be justification for delays or additional compensation to CONTRACTOR.

- 3. Submit Construction Schedules as provided in Project Manual.
- 4. Submissions shall be made to the OWNER's office with simultaneous submittal to the OWNER. Data and correspondence that originates with Subcontractors and suppliers must be submitted to the OWNER through the CONTRACTOR. CONTRACTOR to approve all submittals prior to submission to the OWNER.
- 5. CONTRACTOR shall provide names, proof of competent person, telephone number of competent person where person can be reach twenty-four (24) hours a day and training of person on-site during construction. Also provide name and number of safety officer.
- 6. Submit shop drawings and product data in accordance with the approved/accepted submittal schedule. Also submit shop drawings, product data and all other submittals to the OWNER for review prior to their need for the Work. Allow sufficient time for a submittal and re-submittal to be reviewed by the OWNER. Allow time to make delivery of material or equipment after submittal is reviewed and accepted by OWNER.
- 7. The CONTRACTOR shall make specific mention of those items that vary from the requirements of the contract documents in the letter of transmittal. The letter of transmittal shall include the specification number, detail name/number, or plan sheet of the item being substituted. Example: Section 15061 PVC Pressure Pipe.
- 8. Submittals shall verify compliance with the contract documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, CONTRACTOR shall submit a complete initial submittal including all components. Incomplete submittals will be returned to CONTRACTOR –reviewed.
- 9. All submittals, regardless of origin, shall be signed and stamped with the approval of CONTRACTOR and identified with the name and number of this contract, CONTRACTOR's name, and references to applicable specification paragraphs and contract drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and non-applicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
- 10. CONTRACTOR shall be solely responsible for the completeness of each submission. CONTRACTOR's stamp of approval is a representation to OWNER that CONTRACTOR accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog number, and similar data, and that CONTRACTOR has reviewed and coordinated each submittal with the requirements of the Work and the contract documents.
- 11. All deviations from the contract documents shall be identified as deviations on each submittal and shall be tabulated in CONTRACTOR's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by CONTRACTOR, including modifications to other facilities

that may be a result of the deviation, and all required piping and wiring diagrams. The CONTRACTOR shall verify that the electrical power requirements, instrumentation and controls for each piece of equipment are coordinated with the electrical drawings. Verify horsepower (or kw), voltage, phase and amperage of the equipment specified to horsepower (or kw), voltage, phase and circuit sizes provided on the electrical drawings. Discrepancies shall be called to the attention of the OWNER.

- 12. Submit shop drawings and product data covering related items of equipment or material or integrated systems of equipment or material at the same time. Partial submissions will not be accepted.
- 13. The CONTRACTOR shall coordinate shop drawings and product data with drawings previously submitted, with drawings being prepared, and with drawings and data previously approved/accepted. All such coordination shall be indicated by reference to the specification, detail or plan sheet.
- 14. The CONTRACTOR shall assign a sequential number to each submittal provided to the OWNER to allow each submittal to be tracked while processing through the review procedures.
 - a. Assignment of numbers shall be by means of a letter prefix, a specification number, a sequence number, and letter suffix to indicate resubmittals. For example, submittal SD-012-C is the third re-submittal of the twelfth Shop Drawing for the Project.
 - b. The sequence number shall be issued in chronological order. Resubmittals shall be followed by a letter of the alphabet to indicate the number of times a submittal has been resubmitted to the OWNER for processing. As an example, a shop drawing with the number SD-01 indicates that the submittal is the first shop drawing submitted for the project. Shop Drawing Number SD-02-A indicates that the submittal is the second shop drawing submitted for and is being submitted for the second time. Acceptable prefixes for submittals are as follows:
 - (i) SD Shop Drawing
 - (ii) RD Record Data
 - (iii) OM Operation and Maintenance Manual
 - c. Correct assignment of numbers is essential as different submittal types are processed in different ways. Some submittals received do not require that any response be given for the material. CONTRACTOR and OWNER shall both maintain a log of submissions to allow the processing of CONTRACTOR's submittals to be monitored. Logs will be reviewed periodically to determine that all submittals are received and processed.
 - d. Submittals shall be marked to show clearly the applicable sections of the specification and sheet number of drawings.
 - e. Submittals shall be accompanied by a Submittal Transmittal Form to be provided by the OWNER. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate discrete sections, etc. for which a submittal is required. Submittals for various items shall be made with a single form when the items taken together constitute a CONTRACTOR's package or are so functionally related that they should be checked as a unit.
- 15. The CONTRACTOR shall not deliver to the site, storage, or incorporate into the Work, any materials or equipment for which approved/accepted submittals have not been obtained.

D. OWNER'S Responsibility

- 1. OWNER review of submittals shall cover only general conformity to the drawings and specifications, external connections, and dimensions which affect the layout. OWNER's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. OWNER'S review shall not relieve CONTRACTOR of CONTRACTOR's sole responsibility for errors, omissions, or deviations in the drawings and data, nor of CONTRACTOR'S sole responsibility for compliance with the contract documents.
- 2. OWNER submittal review period will be twenty one (21) consecutive calendar days in length and shall commence on the first calendar day immediately following the date of arrival of the submittal or resubmittal in OWNER'S office. A minimum of fourteen (14) calendar days shall be allotted for the review of each RFI. Allow more time for large, voluminous or complex submittals. Delays caused by resubmittal and subsequent reviews shall be the responsibility of the CONTRACTOR. The time required to mail the submittal or resubmittal back to CONTRACTOR will not be considered a part of the submittal review period.
- 3. OWNER will attempt to review each submittal and act upon it within twenty one (21) calendar days after receipt. OWNER shall not be responsible for any delays in the review and return of the submittal. OWNER shall not to be liable to CONTRACTOR for any claim, loss, expense, damage or delay arising out of or resulting from any such delay.
- 4. OWNER review, approval/acceptance, or other appropriate action regarding CONTRACTOR's submissions shall be only for conformity with the design concept of the Project and for compliance with the information contained in the contract documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the contract documents) or to safety precautions or programs incident thereto. The review and approval/acceptance of a separate component item shall not indicate approval/acceptance of the assembly into which the item is functionally integrated. CONTRACTOR shall make corrections required by OWNER, and shall return the required number of corrected copies of shop drawings to the OWNER. CONTRACTOR may be required to resubmit as required revised shop drawings or samples for further review and approval/acceptance. CONTRACTOR shall direct specific attention in writing to any new revisions not specified by CONTRACTOR on previous CONTRACTOR submissions.
- 5. The OWNER review does not relieve the CONTRACTOR of the obligation and responsibility to coordinate the Work and plan the details of the Work.
- 6. Shop drawings will be marked in one of the following ways:
 - a. NO EXCEPTIONS: Furnish item as submitted.
 - b. EXCEPTIONS AS NOTED: Furnish item with changes as noted.
 - c. REVISE AND RESUBMIT: Shop drawings having significant errors or incomplete data shall be revised and resubmitted for subsequent review after corrections have been made or additional materials are available.
 - d. REJECTED: Material or equipment described is not acceptable.
 - e. FOR INFORMATION ONLY: Submittal will not be reviewed by the OWNER. OWNER will retain a copy of the submittal for file.
- 7. The actions described in above Paragraph signify the following:
 - a. No Exceptions: Signifies equipment and material represented in the submittal is in general conformance with the design concept and generally complies with the intent of the Contract Documents. CONTRACTOR is to proceed with fabrication or procurement of the items and with related Work. Acceptance of the submittal does not relieve the CONTRACTOR from compliance with the requirements of the plans, specifications and applicable laws, codes and regulations. Acceptance of a specific item shall not include Acceptance of an assembly of which the item is a component. The CONTRACTOR is responsible for verification of dimensions and correlating to the jobsite, information pertaining solely to the fabrication process or to the means, methods, techniques, sequences and procedure of construction, coordination of the Work with that of other trades and performing all Work in a safe and satisfactory manner.
 - b. Exceptions as Noted: Signifies equipment and material represented by the submittal is in general conformance with the design concept and generally complies with the intent of the Contract Documents, except for OWNER's notations and comments. CONTRACTOR to proceed with fabrication of the items and with related Work in strict accordance with OWNER's notations or comments. If the CONTRACTOR desires a variance from the OWNER's notations or comments the CONTRACTOR shall submit the revised Submittal in its entirety to OWNER and not proceed on any variance until a "No Exceptions" action is received from the OWNER. OWNER may request written confirmation from the CONTRACTOR notations and comments.
 - c. Revise and Resubmit: Signifies that the submittal has significant errors, or incomplete data for OWNER to review. CONTRACTOR to revise the submittal, provide additional materials required to complete the submittal. CONTRACTOR to verify that the submittal is complete and meets the requirements of the Contract Documents prior to resubmitting to the OWNER.
 - d. Rejected: Signifies equipment and material represented by the Submittal does not appear to be in general conformance with the design concept, and does not generally comply with the intent of the Contract Documents. Equipment or material submitted is not acceptable.
 - e. For Information Only: No further action is required by the CONTRACTOR. CONTRACTOR is solely responsible for this item.
- 8. When the drawings and data are returned marked "REJECTED", "EXCEPTIONS AS NOTED", or "REVISE AND RESUBMIT", the corrections shall be made as noted thereon and as instructed by OWNER, corrected copies resubmitted. CONTRACTOR shall upload response acknowledging noted items in "EXCEPTIONS AS NOTED" submittal.
- 9. When the drawings and data are returned marked "EXCEPTIONS AS NOTED", or "NO EXCEPTIONS", unless also marked with the statement "WRITTEN RESPONSE REQUIRED" no additional copies need be furnished. If response is required CONTRACTOR shall respond in writing to each of the OWNER's comments.
- 10. The OWNER reserves the right to require written confirmation from the CONTRACTOR that the comments placed on submittals stamped "EXCEPTIONS AS NOTED" shall actually be followed.
- 11. Review by the OWNER shall not be construed as relieving the CONTRACTOR of the responsibility for the accuracy, proper fit, functioning, or performance of the Work.

- 12. Payment shall not be made for Work performed without the required approved/accepted submittal.
- E. Resubmittal of drawings and data. CONTRACTOR shall accept full responsibility for the completeness of each resubmittal. CONTRACTOR shall verify that all corrected data and additional information previously requested by OWNER are provided on the resubmittal.
 - 1. When corrected copies are resubmitted, CONTRACTOR shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by OWNER on previous submissions.
 - 2. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the resubmittal.
 - 3. Resubmittals shall be made within sixty (60) days of the date of the letter returning the material to be modified or corrected, unless within thirty (30) days CONTRACTOR submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.
 - 4. Any need for more than one (1) resubmission, or any other delay in obtaining OWNER'S review of submittals, shall not entitle CONTRACTOR to extension of the contract times unless delay of the Work is directly caused by a change in the Work authorized by change order or by failure of OWNER to review any submittal within the submittal review period specified herein and to return the submittal to CONTRACTOR.
- F. Color selection. CONTRACTOR shall submit color and finish samples for all accepted products to the OWNER. OWNER will prepare a schedule of finishes including the color and finish selections and will furnish this schedule to CONTRACTOR within sixty (60) days after the acceptance date of the last color or finish sample. The schedule of finishes shall include the colors selected for manufactured products and the colors and finishes selected for surfaces to be field painted or finished.
- 1.05 PRODUCT DATA
 - A. Product data, including materials reproduced from CONTRACTOR'S product catalogs shall not be formatted to print larger than 8-1/2-inch by 11-inch in size.
 - B. Catalog data shall be explicit with regard to the name of the CONTRACTOR and to the details of the products being furnished. It shall also be complete enough to enable the OWNER to determine that the products being submitted conform to the requirements of the specifications.
 - C. For submittals with more than one style or size of a product on a sheet, the CONTRACTOR shall clearly indicate which product is being submitted for review.
 - D. Pre-approved and Pre-qualified Products.
 - 1. Products proposed as alternates to "approved" products, provide information required to demonstrate the proposed products meet the level of quality and performance criteria of the "approved product".

1.06 SHOP DRAWINGS

- A. The CONTRACTOR shall reasonably check and verify all field measurements and shall submit to the OWNER for review and approval. These shop drawings shall bear a stamp from the CONTRACTOR that indicates that the CONTRACTOR has reviewed the shop drawings and that the submittal is complete.
- B. The CONTRACTOR shall submit detailed drawings and descriptions of proposed deviations from details or component arrangement indicated on the plans.
- C. Single line drawings shall not be acceptable. Copies of the plans shall not be accepted for submission as drawings, nor shall catalog numbers alone of materials or equipment.
- D. All shop drawings shall be submitted and approved/accepted before authorization to proceed is issued.

1.07 SAMPLES

- A. The CONTRACTOR shall furnish samples of items and materials as required. Samples shall be submitted to the OWNER in duplicate. Each sample shall be properly labeled and identified by providing the following:
 - 1. Date
 - 2. Job name for which it is offered
 - 3. Specification section and paragraph
 - 4. CONTRACTOR'S name
 - 5. Supplier and trade name
 - 6. Other data indicating conformance to specifications.
 - 7. Color charts or samples with CONTRACTOR'S number.
- B. Samples shall be reviewed and signed by a registered professional.
- C. Place CONTRACTOR's Stamp on each sample or a firmly attached sheet of paper, as described in Specification Section 01300, Submittal Procedures.
- D. Submit the number of samples specified in the Specifications; one of which shall be retained by the OWNER.
- E. Reviewed samples which may be used in the Work are identified in Specifications.

1.08 CONTRACTOR'S CERTIFICATES AND AFFIDAVITS

- A. Where specified in the contract documents that a certificate and affidavit shall be submitted to the OWNER for review of a particular product, or component of a product, such submittals shall be made in accordance with the following:
 - 1. A certificate submitted for a product, or component of a product, indicates test results proving that product, or component of a product, meets the requirements of the standard specified in the contract documents.

- 2. A CONTRACTOR's Stamp, as described in paragraph 1.04.C.09, shall be placed on the front page of the certification.
- 3. An affidavit consisting of a sworn statement by an official of the company manufacturing the product indicating that the information on the certificate is true and accurate shall accompany the certificate.
- 4. A statement from the CONTRACTOR, or his Subcontractors, suppliers, or other agent which indicates that a particular item of equipment, product, or component of a product, meets the requirements of the Contract Documents shall not be considered a certificate and shall not be approved/accepted.

1.09 CONTRACTOR'S REPRESENTATIVE

- A. The CONTRACTOR shall include in the contract price the cost of furnishing competent and experienced CONTRACTOR'S representatives who shall represent the CONTRACTOR on products finished and to assist the CONTRACTOR to install the products in conformity with the contract documents. A list of representatives shall be provided to Brownsville Public Utilities Board with the submittals.
- 1.10 PROJECT RECORD DOCUMENTS
 - A. Submit Project Record Documents in accordance with Specification Section 01720.
- 1.11 MISCELLANEOUS SUBMISSIONS
 - A. The following documents shall be submitted by the CONTRACTOR both electronically using the OWNER's designated site and in hard copy in the quantities indicated below:
 - B. Quality Control (QC) Plan Submit one (1) electronic final copy and two (2) paper final copies to the OWNER. QC Plans must be submitted, reviewed and approved/accepted prior to commencing of Work.
 - C. Accident reports one (1) electronic final copy and one (1) paper final copy to the OWNER.
 - D. Inspection and test reports one (1) electronic final copy and one (1) paper final copy to the OWNER.
 - E. Guarantees and warranties one (1) electronic final copy and one (1) paper final copy to the OWNER.
 - F. Erosion and Sedimentation Control Plan one (1) electronic final copy and two (2) paper final copies to the OWNER.
 - G. Operation and Maintenance Manuals one (1) electronic final copy and two (2) paper final copies to the OWNER.
 - H. Design Mixes one (1) electronic final copy and two (2) paper final copies to the OWNER, when specified in Specifications. CONTRACTOR's Stamp, as described in Specification Section 1.04.C.09, shall be placed on the front page of each design mix. Mark each design mix to identify proportions, gradations, and additives for each class

and type of design mix submitted. Include applicable test results on samples for each mix. Maintain a copy of approved design mixes at mixing plant.

- I. The CONTRACTOR must submit a Safety and Health Plan to the OWNER prior to start of construction that complies with current OSHA requirements, industry standards, and appropriate other local, state and federal statutes, ordinances, and regulatory guidelines. The purpose of the safety plan shall be to establish and administer an effective management system to prevent or adequately control loss potential and to minimize personal injuries, occupational illnesses and damage to equipment and property. The objective of the safety plan must be specified and shall be project specific and additional features shall address any unusual or unique aspects of the project for which it is written.
- 1.12 SUPPLEMENTS
 - A. The supplement listed below, following "END OF SECTION", is a part of this specification.
 - 1. Transmittal of Contractor's Submittal
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL

		DATE	•		
то:	s	SUBMTTAL NO:			
		New Submittal	🗌 Re	submitta	al
	I	PROJECT:			
	I	PROJECT NO.			
	(Cover only one section with each su	SPECIFICATION S	SECTION NO.:		
FROM: Contra	actorS	CHEDULE DATE	OF SUBMITTAL:		
SUBMITT	AL TYPE: Shop Drawing] Sample 🗌 Infor	mational		
The follow	wing items are hereby submitted:				
Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
•				No	Yes
	CTOR bereby certifies that (i) CONTR	ACTOR has comr	lied with the requ	iromonte	s of

CONTRACTOR hereby certifies that (i) CONTRACTOR has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By:__

CONTRACTOR (Authorized Signature)

SPARE PARTS

PART 1 GENERAL

- 1.01 SCOPE
 - A. This section covers furnishing the spare parts and special tools required in these Contract Documents. Included in this section are all the materials and parts necessary to furnish the spare parts and tools specified. CONTRACTOR shall refer to Contract Document Sections for complete list of the spare parts and tools required for each piece of equipment. It is intended that the CONTRACTOR shall provide the specified spare parts and/or tools, if it is specified in the Contract Document Sections and not indicated in this section.
- 1.02 RELATED WORK
 - A. Division 15
 - B. Division 16
- 1.03 REFERENCED STANDARDS
 - A. All Standards referenced in the specification sections listed above shall be incorporated into this specification.
- 1.04 SUBMITTALS
 - A. Submittals shall be made in accordance with the requirements of the General Conditions and Division 1 and the applicable sections of these Contract Documents.
- 1.05 PRODUCT DELIVERY AND STORAGE
 - A. Unless noted otherwise, the spare parts shall be delivered to the OWNER prior to final acceptance of the project. Storage of the parts shall be as directed by the OWNER's personnel.
- PART 2 PRODUCTS
- 2.01 SPARE PARTS AND MAINTENANCE MATERIALS
 - A. As specified in respective sections of Contract Documents.
- PART 3 EXECUTION (NOT USED)

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
 - 1. Qualifications of Meeting Participants
 - 2. Preconstruction Conference Progress Meetings
 - 3. Progress Meetings
- 1.02 QUALIFICATIONS OF MEETING PARTICIPANTS
 - A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of the entity each represents.
- 1.03 PRE-CONSTRUCTION CONFERENCE
 - A. Date, Time, and Location

Conference will be held after execution of the contract and before construction is started at the site. OWNER will fix the date, time, and location of the meeting.

- B. Required Attendance
 - 1. CONTRACTOR's representative with decision making authority and major Subcontractors.
 - 2. OWNER'S representative(s).
 - 3. Representatives of government agencies having any degree of control or responsibility, if available.
- C. OWNER will prepare agenda, preside at meeting, and record and upon request, distribute the audio file of proceedings to all parties.
- D. Agenda
 - 1. Agenda will include, but will not necessarily be limited to, the following:
 - a. Distribution of Contract Documents.
 - b. Designation of responsible personnel.
 - c. Review of subcontractors.
 - d. Coordination with other CONTRACTORS.
 - e. CONTRACTOR's construction schedule.
 - f. Procedures and processing of shop drawings, substitutions, and submittals.
 - g. Procedures and processing of field decisions, requests for information (RFI), request for proposal (RFP), change orders, and contract closeout.
 - h. Procedures and processing of schedule of payments, pay estimates, materials and supplies, and applications for payment.
 - i. Requirements for copies of contract documents.
 - j. Insurance in force.

- k. Use of premises.
- I. CONTRACTOR responsibility for safety and first aid procedures.
- m. Security.
- n. Housekeeping.
- o. Field offices.
- p. Record Drawings.
- q. Letter of Authorization to Proceed.
- r. Any other Project related items.
- E. CONTRACTOR shall be prepared to discuss the following items as a minimum:
 - 1. Distribution and discussion of:
 - a. List of major Subcontractors and suppliers
 - b. Projected construction schedules
 - 2. Critical work sequencing
 - 3. Liquidated damages
 - 4. Major equipment deliveries and priorities
 - 5. Project coordination:
 - a. Designation of responsible personnel
 - 6. Procedures and processing of:
 - a. Field decisions
 - b. RFIs
 - c. Proposal requests
 - d. Submittals/shop drawings
 - e. Change orders
 - f. Applications for payment
 - 7. Adequacy of distribution of contract documents
 - 8. Procedures for maintaining record documents
 - 9. Use of premises:
 - a. Office, work, and storage areas
 - b. OWNER's requirements
 - 10. Construction facilities, controls, and construction aids
 - 11. Temporary utilities
 - 12. CONTRACTOR's safety plan and first-aid procedures
 - 13. Security procedures
 - 14. Housekeeping procedures
 - 15. Submittal schedule
 - 16. Quality control
 - 17. Planned outages
 - 18. Laboratory testing
 - 19. Factory and Field Testing

1.04 PROGRESS MEETINGS

- A. Date and Time
 - 1. Regular monthly meetings or as designated by OWNER.
 - 2. Other meetings are on call.
- B. Place
 - 1. OWNER'S field office or other pre-designated place.

- C. OWNER will prepare agenda and distribute prior to meeting, preside at meetings, and prepare and distribute a transcript of proceedings to all parties. The agenda will include, but not necessarily be limited, to the following:
 - 1. Revisions and/or corrections to previous progress meeting minutes.
 - 2. Unresolved items.
 - 3. Administrative items.
 - 4. Change orders.
 - 5. Shop drawings.
 - 6. Problems, conflicts, observations.
 - 7. Coordination with OWNER and/or other CONTRACTORs.
 - a. Bypasses and/or shutdowns.
 - b. Other.
 - 8. Progress since last meeting.
 - 9. Planned progress for next meeting.
 - 10. Other business.
 - 11. Notices of non-compliance with Contract Documents.
- D. CONTRACTOR shall provide OWNER with a 4-week summary of completed work and a 4-week outlook at upcoming work, at least forty-eight (48) hours prior to meeting and shall be prepared to discuss all items on agenda. CONTRACTOR shall bring copies of their current schedule to each meeting.
- E. Minimum Attendance
 - 1. CONTRACTOR's representative with decision making authority and Subcontractor's representatives present for each party shall be authorized to act on their behalf.
 - 2. OWNER's representative(s).

CONSTRUCTION PHOTOGRAPHS AND VIDEO

- PART 1 GENERAL
- 1.01 GENERAL
 - A. CONTRACTOR shall provide digital photographs and a video showing preconstruction area. Preconstruction video and photographs shall be submitted to the OWNER within ten (10) days of the effective date of the agreement. CONTRACTOR shall provide construction photographs taken on first working day of each month, prior to demolitions, during demolitions, new installations and other significant stages of construction. OWNER shall designate the subject of each photograph. Post-construction video shall be submitted within ten (10) days following job completion.
- 1.02 DIGITAL QUALITY
 - A. All photographs shall be color photographs of commercial/professional quality. The CONTRACTOR shall provide photographs with a minimum digital photo resolution setting of 10.0 MP. Photographs shall be submitted on a compact disk in jpg format and identified with description of view, and date. Each photo shall be marked with the name and number of contract, name of CONTRACTOR, description and location of view and identity of photographer.
 - B. The pre-construction and post-construction video shall be color video of commercial/professional quality. The CONTRACTOR shall provide a video with a minimum digital video resolution setting of 640 X 480. The video shall be submitted on a digital video disk (DVD) format and identified with description of view, and date. The pre-construction and post-construction video shall be marked with the name and number of contract, name of CONTRACTOR, description and location of view and identity of photographer.

1.03 VIEWS AND QUANTITIES

- A. Minimum of twenty-four (24) digital photographs of the site, of pertinent features thereof, shall be taken before the commencement of Work at the site and promptly submitted to the OWNER.
- B. Minimum of twelve (12) additional digital photographs of the site shall be made each month throughout the progress of the Work at such times as requested by the OWNER and submitted with CONTRACTOR's application for progress payment. A minimum of four (4) digital photographs at each site from each monthly set shall be overview taken from the same view from each month.
- C. The same views of the entire site, or pertinent features thereof, shall be rephotographed upon completion of all construction activities and submitted with CONTRACTOR's application for final payment.

PART 2 PRODUCT (NOT USED)

PART 3 EXECUTION

3.01 EXECUTION

- A. One (1) set of these photographs shall be submitted with the CONTRACTOR's application for progress payment. The digital photographs shall be transmitted to the OWNER.
- B. Technique is to present important factual details with high resolution, minimum distortion, maximum depth-of-field, and sharpness. Views shall adequately illustrate Project status or condition of construction.

SCHEDULE OF VALUES

PART 1 GENERAL

- 1.01 SCOPE
 - A. CONTRACTOR shall develop and submit to the OWNER for approval a schedule of values for the Project.
- 1.02 SUBMITTALS
 - A. Submit preliminary schedule of values in accordance with Section 01300 Submittals.
 - B. Submit corrected schedule of values within ten (10) days upon receipt of reviewed schedule of values, but no later than ten (10) days prior to anticipated submittal of first application for payment, in accordance with Section 01300 Submittals.
 - C. Upon request, support prices with data which will substantiate their correctness.
 - D. If activities are added or removed from the progress schedule revise the schedule of values and resubmit.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTIONS
- 3.01 SCHEDULE OF VALUES
 - A. Within thirty (30) calendar days following the effective date of the contract, the CONTRACTOR shall submit to the OWNER in triplicate a tentative schedule of values (a breakdown of each lump sum bid) which in turn shall be used to determine partial payment estimates and may be used to verify costs of credits, change orders, etc. CONTRACTOR shall also submit these files electronically in the following formats: Word, Excel, and PDF.
 - 1. The tentative schedule of values will be reviewed by the OWNER to determine whether, in his judgment, the schedule of values is of sufficient detail and if the prices included are "unbalanced" or "front-end loaded", in an effort to inflate the prices of those items of Work to be completed in the early stages of the Work.
 - 2. The OWNER will provide the CONTRACTOR with his comments and/or may request additional information from the CONTRACTOR to justify certain item quantities and prices therefore. On the basis of the OWNER'S comments, the CONTRACTOR shall revise and resubmit the tentative schedule for further review and/or approval/acceptance.
 - 3. Once the tentative schedule is accepted by the OWNER, it shall become the schedule of values to be used in determining partial payment estimates. Five (5) copies of this schedule shall be submitted to the OWNER for distribution and his use.
 - 4. No partial payment request (including the first) will be approved or accepted until the schedule of values has been accepted by the OWNER.

- B. Each partial payment request by the CONTRACTOR shall include the accepted schedule of values, modified to indicate the total quantity and price of the Work completed to the date of the request. After acceptance of the schedule of values submittal, no modifications will be made to the schedule of values, except as required by approved/accepted change orders.
- C. In so far as possible, total quantities and unit prices shall be shown for all items of Work, separating for each item the materials and labor and such other sub-items as the CONTRACTOR may desire. "Lump sum", "miscellaneous", and other such general entries in the schedule shall be avoided whenever possible. Such items as bond premiums, insurance, temporary facilities and equipment storage may be listed separately in the schedule of values, provided the costs can be substantiated. Overhead and profit shall not be listed as separate items. Breakdown cost to list major products or operations for each line item which has an installed value of more than \$5,000.00.
- D. The sum of the items listed on the schedule of values shall equal the contract lump sum price. The value for mobilization costs list in the schedule of value shall not exceed ten (10) percent of the subtotal bid amount. No additional payment will be allowed if the quantities shown on the schedule are less than those actually required to accomplish the Work, unless the quantities are altered by a change order.

3.02 FORECASTS OF PAYMENTS

A. Within thirty (30) days after the award of the contract, prepare and submit to the OWNER a chart forecasting the monthly partial payment amounts that are anticipated for this Project. During progress of the job, mark this chart to show actual payments to date and revise the forecast of payments as necessary and submit the revised chart to the OWNER monthly.

QUALITY CONTROL

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section describes the requirements for quality control necessary for the execution of this contract. Requirements within the following subject areas are included:
 - 1. General Quality Control (QC)
 - 2. Workmanship
 - 3. CONTRACTOR's Instructions
 - 4. CONTRACTOR's Certificates
 - 5. Mockups
 - 6. CONTRACTOR's Field Services
 - 7. Testing Laboratory Services
- 1.02 GENERAL QUALITY CONTROL
 - A. CONTRACTOR shall maintain control over Subcontractors, Suppliers, other CONTRACTOR'S, products, services, site conditions, and workmanship to produce Work of a specified quality.
 - B. The CONTRACTOR's quality control responsibilities include, but are not limited to, the following:
 - 1. Providing the quality specified in the plans and specifications.
 - 2. Implementing and maintaining an effective quality control system.
 - 3. Performance of all control activities and tests.
 - 4. Completion of acceptable documentation of quality control activities.
 - 5. The CONTRACTOR shall place a competent person onsite to oversee the quality control system. This person, or approved alternate, must have full authority to act for the CONTRACTOR on quality control matters and shall be on-site during all phases of construction activities. The responsibilities include materials, workmanship, methods, and techniques to provide that all Work is constructed properly by qualified, competent, and professional craftsmen and/or tradesmen. A competent person is one that has been trained in excavation safety, Work zone traffic control, confined space entry, and hazardous materials responsibilities. Additionally, this person must have authority to perform such duties as sign pay requests, negotiate change orders, etc.
 - C. The CONTRACTOR shall document quality control activities performed during the contract by the CONTRACTOR, Subcontractors, testing laboratories, and Vendors in accordance with the contract documents. The CONTRACTOR shall prepare quality control reports consisting of or considering the following items:

- 1. Testing activities, control procedures, test results, nature of deficiencies proposed remedial actions, and corrective procedures instituted.
- 2. Reports shall reference specification section.
- 3. Reports shall include Subcontractor Work.
- 4. Reports should concentrate on Work items that have been completed and provide evidence of control activities.
- 5. Reports shall be submitted on a weekly basis, but always before request for payment on completed Work.
- 6. Reports shall reflect accurate and precise quality control actions taken.
- D. The CONTRACTOR shall develop and submit, for review by Brownsville Public Utilities Board, a detailed Project specific Quality Control Plan after receipt of notice of award and prior to the preconstruction conference. It shall be reviewed and formally accepted prior to the initiation of construction. In some cases, this requirement can be met by an interim plan. This first submission by the CONTRACTOR shall include, as a minimum, a general plan for quality control, plus the specifics for the Work, which is about to begin. The CONTRACTOR shall also state familiarity with specifications and plans (i.e., shoring plans) and assure properly skilled personnel are in place prior to construction. A final acceptable plan must be received within a reasonable time. The plan shall be job-specific and shall address any unusual or unique aspects of the job or activity for which it is written. The Quality Control Plan shall be prepared in accordance with the following concepts. Quality control should be divided into three phases. The phases are as follows, and as a minimum include:
 - 1. PRE-CONSTRUCTION PHASE
 - a. Quality control organization
 - (i) List of personnel/chain of authority
 - (ii) Qualifications of quality control personnel (including Subcontractors, suppliers, CONTRACTOR's)
 - (iii) Name and qualifications of competent person, and alternate.
 - b. Definable construction features
 - (i) List of definable features/items
 - (ii) Schedule of values for all definable features shall be submitted and approved/accepted prior to submittal of first pay request.
 - c. General administrative procedures
 - (i) Identify all responsible personnel (CONTRACTOR authorized representatives to sign contract documents, pay request, change orders, etc.)
 - (ii) Identify all construction forms/procedures required
 - (iii) Identify all BPUB personnel, etc. responsible for review/acceptance of submittals and construction activities.
 - d. CONTRACTOR coordination with other agencies
 - (i) Identify all agencies and a contract person from each agency as appropriate (including but not limited to: City of Brownsville Departments, Cameron County Departments, Texas Department of Transportation, Texas Commission for Environmental Quality, Brownsville Public Utilities Board, etc.)
 - (ii) Identify all existing utilities/field conditions as appropriate (including but not limited to: Brownsville Public Utilities Board, City Public Service, Southwestern Bell Telephone, Paragon Cable, etc.)

- e. Submittals
 - (i) Identify appropriate, including but not limited to: all definitions, procedures, product data, shop drawings, samples, CONTRACTOR's certificates/warranties, etc.
 - (ii) Prepare a schedule of specified submittals to be submitted for review and approval/acceptance (verify all material and contract requirements).
 - (iii) Identify Brownsville Public Utilities Board personnel, etc. responsible for the review and acceptance of Project submittals.
 - (iv) Prepare a Construction Project Safety Program (CONTRACTOR and Subcontractors) in accordance with Brownsville Public Utilities Board Construction Safety Program guidance document.
 - (v) Testing laboratory services (to be used by CONTRACTOR): submit data for review and approval/acceptance of laboratory as specified in the contract documents.

Material Testing – All tests performed shall be recorded and numbered. One (1) copy shall be maintained at jobsite, and two (2) copies shall be given to OWNER. Attach testing analysis data of materials to be used on the Project to the appropriate material submittal. Submit a quality control testing plan (example backfill material, roadway construction material compaction testing, concrete material testing, pipe testing, density testing, motors/pumps tests, other tests as required or appropriate). Testing requirements and procedures shall include but not be limited to:

- (a) Provide and outline of proposed testing procedures.
- (b) Provide a listing of all required tests as specified in the contract, in addition to providing a listing of all non-specified testing procedures pending approvals/acceptances.
- (c) Specify whether the tests are to be performed by an independent, Brownsville Public Utilities Board approved certified testing laboratory or by the CONTRACTOR with Brownsville Public Utilities Board approved certified equipment and procedures or by others (Subcontractors or suppliers) approved by Brownsville Public Utilities Board.
- (d) ASTM 3740-96 Minimum requirement for agencies engaged in the testing and/or inspection of soil and rock as used in engineering design and construction.
- (e) Repair all materials and equipment that fail during testing with no additional compensation.
- (f) Provide all required materials, labor, equipment, water, and power required for testing.

1.03 CONSTRUCTION PHASE

- A. Prepare written procedures with respect to issues including:
 - 1. Construction sequencing
 - a. Construction schedule: include but not limited to: bar graphs, phasing plans, network diagrams, critical path item identification, equipment/material/supplies delivery impact, narrative reports, etc.
 - (i) Shop drawing logs
 - (ii) Submittal logs
 - (iii) Request for information logs
 - (iv) Traffic control plans

- (v) Coordinate use of OWNERS premises
- b. Including but not limited to layout of temporary facilities, temporary utilities and controls, security, field office and storage facilities, operation of OWNERS valves, facilities, tie-ins, by-pass pumping, flow diversion or interruption of OWNER's facilities, etc.
- c. Preparation of right of way
- d. Temporary controls
 - (i) Including but not limited to: erosion and sedimentation controls, dust control, construction noise control, etc.
 - (a) Surveying
 - (b) Delivery, storage, inspection and installation of materials
 - (c) Testing of on-site materials and equipment
 - (d) CONTRACTOR's field services
 - (e) Training schedule
 - (f) Starting of systems
- 2. CONSTRUCTION COMPLETION PHASE

Prepare written procedures with respect to issues including:

- a. Equipment training
- b. CONTRACTOR's inspection/acceptance reports (as applicable)
- c. Deficiency punch lists
- d. Removal of utilities, facilities and controls
 - (i) Plan and coordinate with proper personnel and/or agencies.
- e. Coordinate system operation turn-over to OWNER
- f. Complete all post construction documentation/administration (as required by contract)
- g. Project record documents
 - (i) Maintain records and documents throughout construction process.
 - (ii) Prepare final submittals on items required (include but not limited to: asbuilt drawings, specifications and addenda, approved/accepted shop drawings, material samples, construction photographs, change orders, contract modifications, testing and analysis records, survey data, construction reports such as daily reports, monthly reports, payroll records, and safety data such as MSDS, safety meetings, incident reports, etc.).
- B. Quality assurance (QA) is the means by which OWNER assures that the completed Project complies with the quality established by the construction contract documents. The OWNER will assure that the quality control will be accomplished through reviews, observation and tests by the OWNER's construction observer, owner's ENGINEER, or any other authorized OWNER representative.

1.04 WORKMANSHIP

- A. CONTRACTOR will comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship is required.
- B. CONTRACTOR will produce Work that meets or exceeds workmanship standards described in these specifications.

1.05 CONTRACTOR'S INSTRUCTIONS

- A. CONTRACTOR shall comply with published instructions in full detail, including each instep sequence recommended by the CONTRACTOR. In the event that these instructions conflict with these specifications, the CONTRACTOR shall obtain clarification from the OWNER.
- 1.06 CONTRACTORS' CERTIFICATES
 - A. CONTRACTOR shall submit CONTRACTOR certificates that guarantee compliance with the specified requirements when indicated by these specifications.
- 1.07 MOCKUPS
 - A. CONTRACTOR shall erect and remove full-scale mockups of selected assemblies at the Project site when required by these specifications.
- 1.08 CONTRACTORS' FIELD SERVICES
 - A. As specified in Section 01640 CONTRACTOR's Field Services, and when required in respective specification sections, the CONTRACTOR shall provide qualified personnel to observe field conditions; conditions of surfaces and previous installations; quality of workmanship; start-up of equipment; test, adjust, and balance of equipment as applicable, and to make appropriate recommendations.
 - B. CONTRACTOR shall submit written report to the OWNER listing CONTRACTOR's observations and recommendations.
- 1.09 TESTING LABORATORY SERVICES
 - A. Testing, sampling, inspection and certifications of materials and equipment specified in the Technical Sections of this Project Manual shall be paid by the CONTRACTOR and shall be by agencies agreeable to the OWNER. This provision and Paragraph V of the General Conditions shall take precedence even if indicated otherwise in other Technical Sections.
 - B. Sampling of materials and laboratory testing of materials shall be performed at the expense of the CONTRACTOR in an independent, certified commercial testing laboratory. The selection of the laboratory is subject to the review and approval of the OWNER.
 - C. Sampling and testing of equipment shall be performed at the expense of the CONTRACTOR by an independent certified commercial testing laboratory acceptable to OWNER.
 - D. The CONTRACTOR shall submit the name and qualifications of the laboratory to the OWNER for review no less than thirty (30) calendar days prior to the date the laboratory is to be used. The qualifications of outside testing laboratories will meet or exceed the following:
 - 1. Satisfy "Recommended Requirements for Independent Laboratory Qualifications," published by American Council of Independent Laboratories.

- 2. Satisfy requirements of ASTM E329, "Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Construction."
- 3. Submit a copy of report of the inspection of the facilities made by the Materials Reference Laboratory of National Bureau of Standards during the most recent inspection, with a memorandum of remedies of any deficiencies reported by the inspection.
- 4. Submit copies of the recent certificates of calibration for all pertinent devices within the laboratory that will be used in required testing for this Work.
- 5. Conduct testing in accordance with the requirements of governing authorities and specified standards.
- 6. Provide reports to the OWNER that conform to the requirements contained in Section 01300 Submittals giving observations and results of tests, indicating compliance or non-compliance with standards and with these specifications.
- E. The OWNER may require special inspection, testing or approval of material or Work for determining compliance with the requirements of the contract documents. The CONTRACTOR shall arrange for such special testing, inspection or approval procedure. Should the material or Work fail to comply with the requirements of the contract documents, the CONTRACTOR shall bear all costs of the special testing, inspection or approval as well as the cost of replacement of any unsatisfactory material or Work as provided by the General Conditions, otherwise, should the Work prove not defective, the OWNER shall bear such costs and an appropriate change order shall be issued.

ABBREVIATIONS

PART 1 GENERAL

- 1.01 REFERENCE TO ABBREVIATIONS OF STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES
 - A. Reference to abbreviations of standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in The BPUB General Conditions, and as may otherwise be required herein and in the individual specification sections.
 - B. Work specified by reference to the published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet the requirements or surpass the minimum standards of quality for materials and workmanship established by the designated standard or specification.
 - C. Where so specified, products or workmanship shall also meet or exceed the additional prescriptive or performance requirements included within the contract documents to establish a higher or more stringent standard of quality than that required by the referenced standard.
 - D. Where two (2) or more standards are specified to establish quality, the product and workmanship shall meet or exceed the requirements of the most stringent.
 - E. Where both a standard and a brand name are specified for a product in the contract documents, the proprietary product named shall meet or exceed the requirements of the specified reference standard.
 - F. Copies of standards and specifications of technical societies.
 - 1. Copies of applicable referenced standards have not been bound in these contract documents.
 - 2. Where copies of standards are needed by the CONTRACTOR, obtain a copy or copies directly from the publication source and maintain in an orderly manner at the site as Work site records, available to the CONTRACTOR's personnel, Subcontractors, and OWNER.

1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies:

Following is a list of construction industry organizations and government agencies to which references may be made in the contract documents, with abbreviations used.

1	AA	Aluminum Association
2	AAMA	American Architectural CONTRACTORs Association
3	AAN	American Association of Nurserymen
4	AASHTO	American Association of State Highway and Transportation Officials
5	ACI	American Concrete Institute
6	AFBMA	Anti-Friction Bearing CONTRACTORs' Association
7	ACIL	American Council of Independent Laboratories
8	AGA	American Gas Association
9	AGC	Associated General Contractors of America
10	AGMA	American Gear CONTRACTORs' Association
11	AI	Asphalt Institute
12	AISC	American Institute of Steel Construction
13	AISI	American Iron and Steel Institute
14	AMA	Acoustical Materials Association
15	ANSI	American National Standards Institute
16	API	American Petroleum Institute
17	APWA	American Public Works Association
18	ASA	American Standards Association
19	ASAE	American Society of Agricultural Engineers
20	ASCE	American Society of Civil Engineers
21	ASNT	American Society for Nondestructive Testing
22	ASME	American Society of Mechanical Engineers
23	ASTM	ASTM International (Formerly named: American Society for Testing and Materials)
24	AWS	American Welding Society
25	AWWA	American Water Works Association
26	BHMA	Builders Hardware CONTRACTORs' Association
27	BPUB	Brownsville Public Utilities Board
28	CBMA	Certified Ballast CONTRACTORs' Association
29	CDA	Copper Development Association
30	CGA	Compressed Gas Association
31	CIPRI	Cast Iron Pipe Research Institute
32	CISPI	Cast Iron Soil Pipe Institute
33	CRSI	Concrete Reinforcing Steel Institute

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34	CS	Commercial Standard
35	CSA	Canadian Standards Association
36	CSI	Construction Specifications Institute
37	CTSS	Caltrans Standard Specification
38	DIPRA	Ductile Iron Pipe Research Association
39	EJCDC	Engineers Joint Contract Documents' Committee
40	EPA	Environmental Protection Agency
41	ETL	Engineering Test Laboratories
42	FCC	Federal Communications Commission
43	FEMA	Federal Emergency Management Agency
44	FM	Factory Mutual
45	Fed. Spec.	Federal Specifications
46	FS	Federal Specification
47	НІ	Hydraulic Institute
48	ICBO	International Conference of Building Officials
49	ICEA	Insulated Cable Engineers' Association
50	IEEE	Institute of Electrical and Electronics Engineers, Inc.
51	IES	Illuminating Engineering Society
52	IFI	Industrial Fasteners Institute
53	ISA	Instrument Society of America
54	ISO	Insurance Service Office
55	JIC	Joint Industry Conferences of Hydraulic CONTRACTORs
56	MIA	Marble Institute of America
57	Mil. Sp. Or MIL	Military Specification or MIL
58	MS	Military Specifications
59	NAAMM	National Association of Architectural Metal CONTRACTORs
60	NACE	National Association of Corrosion Engineers
61	NAPA	National Asphalt Pavement Association
62	NBHA	National Builders' Hardware Association
63	NCMA	National Concrete Masonry Association
64	NEC	National Electrical Code
65	NECA	National Electrical Contractor's Association
66	NEMA	National Electrical CONTRACTORs' Association
67	NESC	National Electric Safety Code
68	NFPA	National Fire Protection Association
69	NIST	National Institute of Standards and Technology (Formerly known as US – U.S. Bureau of Standards)
70	NSF	National Sanitation Foundation Testing Laboratory
71	NSPE	National Society of Professional Engineers

72	OECI	Overhead Electrical Crane Institute
73	OSHA	Occupational Safety and Health Act (both Federal and State)
74	PCA	Portland Cement Association
75	PCI	Prestressed Concrete Institute
76	PEI	Porcelain Enamel Institute
77	PPI	Plastic Pipe Institute
78	PS	Product Standards Section-U.S. Department of Commerce
79	RMA	Rubber CONTRACTORs' Association
80	SAE	Society of Automotive Engineers
81	SCPRF	Structural Clay Products Research Foundation
82	SDI	Steel Deck Institute
83	SDI	Steel Door Institute
84	SIGMA	Sealed Insulating Glass Manufacturing Association
85	SJI	Steel Joist Institute
86	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
87	SPI	Society of the Plastics Industry
88	SSPC	Steel Structures Painting Council
89	SWI	Steel Window Institute
90	TEMA	Tubular Exchanger CONTRACTORs' Association
91	TCNA	Tile Council of North America (Formerly known as TCA – Tile Council of America)
92	TCEQ	Texas Commission on Environmental Quality (Formerly known as TNRCC – Texas Natural Resource Conservation Commission)
93	UBC	Uniform Building Code
94	UFC	Uniform Fire Code
95	UL	Underwriters Laboratories Inc.
96	UMC	Uniform Mechanical Code
97	USBR	U.S. Bureau of Reclamation
98	WCLIB	West Coast Lumber Inspection Bureau

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section describes the requirements for temporary construction facilities and controls that are necessary for the execution of this contract. Requirements within the following subject areas are included:
- B. Layout of temporary facilities
- C. Project identification
- D. Temporary utilities
- E. Barriers
- F. Protection of existing work
- G. Temporary controls
- H. Security
- I. Field offices and storage facilities
- J. Hazardous materials
- K. Removal of utilities, facilities, and controls.
- L. Permits
- 1.02 LAYOUT OF TEMPORARY FACILITIES
 - A. Temporary Facilities at the Construction Site
 - Allocation shall be made by the OWNER for space located on the OWNER's property, as shown on the plans. If additional space is required, the CONTRACTOR shall coordinate with OWNER for additional space on the plant site. CONTRACTOR shall be responsible for security within temporary facilities and shall provide any desired temporary fencing and other security measures along with tree protection, erosion control, etc.
 - 2. The CONTRACTOR shall submit for review working drawings that show the proposed location and size of offices, sanitary facilities, temporary construction roads, shops, storage areas, fencing, temporary stationary equipment, temporary power service and distribution, and other similar facilities. The CONTRACTOR shall be required to provide a construction trailer/office for their own use.
 - 3. The CONTRACTOR shall take care to ensure that the location of any temporary facility does not impede the performance or inhibit the operation of the OWNER's facility or adjacent facilities.

4. If necessary, off-site storage facility shall be in a climate/temperature-controlled environment.

1.03 PROJECT IDENTIFICATION

- A. The CONTRACTOR shall furnish and install at each lift station site, during construction, one (1) 8-foot wide by 4-foot high Project signs of exterior grade A-C plywood and wood frame construction, painted, with exhibit lettering by a professional sign painter to OWNER'S design and colors. Posts shall be embedded with a minimum of 3-foot below ground surface. Signs shall be mounted on two (2) 4-inch by 4-inch by 12-foot posts.
- B. Refer to attached Exhibit 1 for items to be shown on sign. Obtain final information items to be shown from the OWNER.
- C. Erect on-site at a location established by the OWNER.
- D. No other signs are allowed without the OWNER's permission, except those required by law.
- 1.04 TEMPORARY UTILITIES
 - A. General
 - 1. Provide and maintain temporary and interim utility services necessary for the performance of the Work. All costs associated with these services shall be included in the CONTRACTOR's price for mobilization. This includes power for testing and startup.
 - 2. Install and maintain utilities to comply with applicable code, safety, and utility company requirements.
 - 3. Use of permanent utilities or equipment during construction shall not constitute start of warranties or guaranties.
 - B. Electricity
 - 1. The CONTRACTOR shall determine the type, amount required and make arrangements for providing temporary electric power. The CONTRACTOR shall pay the cost of obtaining temporary electric power.
 - 2. The CONTRACTOR shall provide connections sized to provide service for power and lighting. Feeder and branch wiring with area distribution boxes, if deemed necessary, shall be located so that power is available throughout the shop/office compound by use of power cords. Terminations shall be provided for each voltage supply complete with circuit breakers, disconnect switches and other electrical devices as required to protect the power supply system.
 - 3. The CONTRACTOR shall provide and maintain adequate lighting for construction operations, conforming to applicable laws and regulations.
 - 4. Temporary electrical power for use during construction shall not interfere with, or adversely affect, the normal operation of any of the OWNER's facilities or adjacent facilities.
 - 5. Temporary electric power installation shall meet the construction safety requirements of NEC, OSHA, State and other governing agencies.

- C. Temporary Electrical Lighting
 - 1. In Work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by Occupational Safety and Health Administration (OSHA) and state agency which administers OSHA regulations where Project is located.
 - 2. When available, permanent lighting facilities may be used in lieu of temporary facilities
 - a. Prior to final acceptance of the Work, replace bulbs, lamps, or tubes used by CONTRACTOR for lighting.
- D. Temporary Ventilation
 - 1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Telephone Service
 - 1. The CONTRACTOR shall furnish on-site telephone service for himself during period of construction of the contract.
- F. Water Service
 - 1. CONTRACTOR shall provide water service and backflow preventer for general construction operations.
 - 2. CONTRACTOR shall obtain a separate meter and reimburse the OWNER for any water used (except as described in other sections).
 - If non-potable water (NPW) will be used for construction operations, CONTRACTOR shall use meter provided by BPUB to measure the amount of NPW used and will need to coordinate with the OWNER on the amount of NPW available. CONTRACTOR is responsible for all associated costs.
- G. Sanitary Facilities
 - 1. CONTRACTOR shall provide temporary sanitary facilities and shall service, clean, and maintain these facilities for the duration of construction. Upon completion of the work, all temporary sanitary facilities shall be removed and the area restored to its original condition. CONTRACTOR's personnel shall not be permitted to use OWNER's sanitary facilities.
- H. Trash
 - All trash shall be under the CONTRACTOR's control (no overflow of dumpsters). CONTRACTOR shall provide adequate containers to store trash and remove and dispose of trash in a timely manner and in accordance with city, state, and federal regulations. CONTRACTOR will not use BPUB dumpsters or other BPUB property for disposal.
- I. Fire Protection
 - 1. The CONTRACTOR shall provide temporary fire protection equipment for the protection of personnel and property during construction. This shall include, at a minimum, fire extinguishers and a first aid kit. Debris and flammable material shall be removed weekly to minimize potential hazards.

2. Fires shall be reported immediately to the OWNER.

1.05 BARRIERS

- A. The CONTRACTOR shall provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from construction operations.
- B. The CONTRACTOR shall be able to erect a temporary fence around his construction laydown, staging area within the project property lines.
- C. The CONTRACTOR shall provide barriers to protect plant life designated to remain.
- 1.06 PROTECTION OF EXISTING WORK
 - A. Protect existing Work and provide special protection as required by these specifications.
 - B. Provide temporary and removable protection for existing products. Control activity in the immediate Work area to minimize damage.
 - C. Protect landscaped areas. At least once a month or at the OWNER's discretion, mow the surrounding area of the construction trailer, staging area, and construction area.
- 1.07 TEMPORARY CONTROLS
 - A. Drainage and Erosion Control
 - 1. Erosion and sedimentation controls
 - a. CONTRACTOR shall furnish all labor, materials, equipment and incidentals as shown, specified and necessary to complete the Work required for compliance with the NPDES Storm Water Regulations, Texas Commission on Environmental Quality (TCEQ) Water Pollution Abatement Plan, and any other related state, county, or local requirements. Any issues regarding erosion and sedimentation control shall be referred to the OWNER.
 - b. The CONTRACTOR shall retain the services of a Professional ENGINEER, licensed in the state of Texas and having experience in Storm Water Engineering to design and prepare the Storm Water Pollution Prevention Plan (SWPPP), in accordance with Specification Section 02290. The plans and calculations shall be sealed by the Professional ENGINEER responsible for the design. The CONTRACTOR shall submit the SWPPP to the OWNER and receive the OWNER'S approval prior to mobilization. It shall be construed that this document is included in this Project Manual and shall apply to every section as if written in full therein.
 - c. As a condition of the award of the contract, the CONTRACTOR shall be required to sign and submit a certification as shown at the end of this section.
 - 2. Grade site to drain. Maintain excavations free from water. Provide, operate, and maintain pumping equipment. Final grade site at completion of Work to ensure that no drainage of storm water is blocked.
 - 3. Provide silt barriers as required by the OWNER to protect site from soil erosion.
 - 4. Plan and execute construction methods to control surface drainage from cuts and fills, from borrow and waste disposal areas.

- 5. Minimize the amount of bare soil exposed at one time.
- 6. Periodically inspect construction worksite and adjacent sites to detect evidence of erosion and sedimentation; promptly apply corrective action.
- B. Dust Control
 - 1. Execute Work by methods that minimize the creation of dust.
 - 2. Provide positive means, appropriate amounts of water or other appropriate substances, to prevent dust from dispersing into the atmosphere.
- C. Construction Noise Control
 - 1. The CONTRACTOR shall conduct all of their Work in such a manner as to maintain noise that emanates from the construction site to levels that are consistent to levels specified in the City code.
 - 2. No construction activities with the exception of such items as curing of concrete, maintenance of barricades, etc. will be allowed by the Owner between the hours of 5:00 pm and 8:00 am of the following day unless directed by the Owner of requested in writing by the Contractor and approved by the Owner and the TOW Owner. In addition to now work being permitted on Sundays or holidays, no work shall occur on Saturdays without specific written permission of the Owner's representative forty-eight (48) hours in advance of intent to perform Work. No shall be allowed in urban areas between the hours of 5 P.M. and 8 A.M. Monday through Friday, and all day Saturday and Sunday that produce noise levels that exceed 55 dBA, as measured at the nearest property line of an adjacent residential area. Construction equipment that must be operated near a residentially zoned area on a 24 hour basis shall be shielded by an acoustical enclosure during the hours of 5 P.M. and 8 A.M. unless the shielded noise is less than 55 dBA, measured from the nearest adjacent residentially zoned property line.
 - 3. The CONTRACTOR shall submit to the OWNER plans that identify how construction noise shall be mitigated for the Project. These plans shall include method of construction, the equipment to be used, and types of required acoustical treatment.
 - 4. At no time shall noise violate the latest City of Brownsville zoning ordinance requirements.
 - 5. CONTRACTOR shall locate all machinery to minimize neighbor disturbance and all mufflers and enclosures shall be properly maintained.
- D. Parking
 - 1. The CONTRACTOR shall provide temporary parking areas to accommodate construction personnel. When on-site space is not available, the CONTRACTOR shall make arrangements for satisfactory space off-site. Vehicle parking on existing pavement is not authorized
- E. Access to Businesses, Residences and Cemeteries
 - 1. The CONTRACTOR shall provide for the access of residences and all businesses and cemeteries during all phases of the Work.

- 1. The CONTRACTOR shall at all times keep the Work area and storage area free from rodents, pests, and other vermin.
- 2. The OWNER shall notify the CONTRACTOR on any non-compliance with this requirement. This notice, when delivered to the CONTRACTOR, shall be deemed sufficient notice and that immediate corrective action is required.
- 3. If the CONTRACTOR fails to take effective action to eliminate the vermin problem, then the OWNER may have the necessary extermination Work performed and charge the cost to the CONTRACTOR.

1.08 SECURITY

- A. CONTRACTOR shall provide an armed security guard during all times that work is being performed on the site by CONTRACTOR or his subcontractors. The guard shall be on-site during all times work is being performed, even if CONTRACTOR's work extends beyond the original contract date. The guard should be a commissioned guard from BPUB approved security contractor, or BPUB approved equal. The equal should have familiarity with BPUB facilities, security policies, communication procedures, emergency response codes, and chemical response protocols. The guard shall have NIMS-certification, first aid/AED certification, and shall meet all BPUB requirements for psychological testing.
- B. No Claim shall be made against OWNER by reason of any act of an employee or trespasser, and CONTRACTOR shall make good all damage to OWNER 's property resulting from CONTRACTOR's failure to provide security measures as specified. Other security measures shall be at least equal to those usually provided by OWNER to protect OWNER 's existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, and other measures as required to protect the Site.
- C. Contract work at BPUB designated critical facilities (primary/secondary pumping stations, heating/cooling plants, treatment plants, and the Central Office complex) must comply with the following:
 - 1. The CONTRACTOR and all the CONTRACTOR's representatives and subcontractors shall obtain a security badge from BPUB prior to entering the site. The acquisition of the security badge shall take place prior to mobilization and it is the CONTRACTOR's responsibility to obtain the badge in a timely manner so as not to delay his work. The CONTRACTOR and subcontractors must at all times, while on the critical site, have and display their badge credential (must contain employee name, company name and photo of employee) for verification against the BPUB CONTRACTOR badge in order to be allowed entry or to work on the project site. Wearing/display of the badge does not apply if the work being performed could result in danger to the employee or damage/loss of the badge. Where subs do not have a company photo with name, they may use their driver's license; but either a company photo badge or the license MUST be used while working on the BPUB site.
- D. The CONTRACTOR shall restrict entry of persons and vehicles onto the project site(s) allowing entry only to authorized persons with proper identification. CONTRACTOR shall maintain a log of workmen and visitors and make log available on-site to OWNER upon request. The CONTRACTOR shall not allow cameras on-site or photographs taken except by the OWNER or ENGINEER or by written approval of OWNER.

1.09 FIELD OFFICES AND STORAGE FACILITIES

- A. Field Offices
 - The CONTRACTOR shall provide and maintain a temporary field trailer office at the project site throughout the duration of construction. A sign identifying the CONTRACTOR and listing emergency telephone numbers shall be posted outside of the CONTRACTOR'S field office. CONTRACTOR shall provide the necessary temporary utilities for the trailer. CONTRACTOR shall submit for approval the location intended for the field office.
 - 2. A separate field trailer is not required in the event the CONTRACTOR already has a construction trailer on-site.
- B. Storage Facilities for Tools, Materials, and Equipment
 - The CONTRACTOR shall provide weather-tight storage facilities at least 12 foot by 12 foot equipped with heat and ventilation for products requiring controlled conditions throughout the duration of construction. It shall also contain adequate space for organized storage and access, as well as lighting for inspection of stored items. No leaking equipment or materials will be acceptable on the project site.

1.10 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA

- A. Submit a Material Safety Data Sheet (MSDS) (Department of Labor Form OSHA-20), as prescribed in 29CFR 1926, OSHA 2079, Construction Standards and Interpretations, for hazardous material five (5) calendar days before delivery of the material, whether or not listed in Appendix A of the Standard. This obligation applies to materials delivered under this contract which shall involve exposure to hazardous materials or items containing these materials.
- B. "Hazardous Material", as used in this clause, is as defined in 29CFR 1926, in effect on the date of this contract.
- C. The CONTRACTOR shall comply with applicable federal, state, and local laws, codes, ordinances, and regulations including the acquisition of licenses and permits in connection with hazardous materials.
- D. All fuel delivered and used on BPUB property shall comply with SPCC requirements (i.e., proper containment, no open container that would allow rainwater to collect, etc.).

1.11 YARD MAINTANCE

- A. Site Yard Work. CONTRACTOR shall retain the services of a yard maintenance Subcontractor who shall be responsible for maintaining the entire yard throughout the duration of the project. From April to October, Yard Maintenance Subcontractor shall cut the grass and edge the entire site at least 2 times per month. From November to March, yard maintenance Subcontractor shall cut the grass at least one time per month.
- 1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
 - A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to final payment, or when directed.

- B. Remove underground installations to a depth of 2 feet, and grade to match surrounding conditions unless otherwise directed in contract documents.
- C. Clean and repair damage caused by installation or removal of temporary facilities.
- D. Restore existing facilities used during construction to specified or original condition.
- 1.13 PERMITS
 - A. CONTRACTOR is responsible for obtaining all city or other regulatory permits required for the temporary facilities.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

ACKNOWLEDGEMENT OF POLLUTION ABATEMENT COMPLIANCE (To Be Submitted with Bid Proposal)

§ §

THE STATE OF TEXAS COUNTY OF _____

CONTRACTOR'S ACKNOWLEDGEMENT OF POLLUTION ABATEMENT COMPLIANCE

I hereby attest that as of the date hereof, I have read and familiarized myself with the Pollution Abatement and Sediment and Erosion Control Plans and Specifications for this project and EPA's NPDES Construction Storm Water Regulations and that I have made an independent diligent effort to identify all other applicable state and local regulations related to this specification.

I hereby attest that I have considered the conditions required by the Pollution Abatement and Sediment and Erosion Control Plans and Specifications for this project, the EPA's NPDES Construction Storm Water Regulations and the other applicable and related state and/or local regulations and that cost for measures necessary to comply fully with these conditions, regulations and requirements have been and are included in the bid proposal submitted herewith.

	By: Title:	
STATE OF TEXAS § COUNTY OF§		
This instrument was acknowledged be	fore me on this	, 20,
by	, the	
of	on behalf of said corporation.	
My Commission Expires:	Notary Public in and for the State of Texas	
	Typed or Printed Name of Notary	
	END OF SECTION	



MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This section describes the requirements for material and equipment that are necessary for the execution of this contract. Requirements within the following subject areas are included:
 - 1. Products
 - 2. Preparation for shipment
 - 3. Packaging and delivery of spare parts and tools
 - 4. Shipment and handling
 - 5. Inspection
 - 6. Storage and protection
 - 7. Inventory control
 - 8. Product options
 - 9. Substitutions
 - 10. Systems demonstration

1.02 PRODUCTS

- A. The term "products" means new material, machinery, components, equipment, fixtures, and systems forming the Work. It does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work. Products may also include existing materials or components required for reuse.
- B. Do not use materials and equipment salvaged from this Project, except as specifically permitted by the plans.
- C. Materials and equipment to be provided under this contract shall be standard products of CONTRACTORS regularly engaged in the manufacture of the products and shall duplicate material and equipment in satisfactory service for at least two years.
- D. Material and equipment shall meet the requirements of the contract and shall be suitable for the installation for which they are planned. Where two (2) or more of the same equipment class are furnished, the equipment shall be from the same CONTRACTOR and shall be interchangeable. Materials and equipment shall be new and free from defects.
- E. Materials and equipment shall be installed in accordance with the requirements of the Plans and approved recommendations of the CONTRACTOR.

1.03 PREPARATION FOR SHIPMENT

- A. When practical, equipment shall be factory assembled. The equipment parts and assemblies that are shipped unassembled shall be furnished with an assembly plan and instructions. The separate parts and assemblies will be match-marked or tagged in a manner to facilitate field assembly.
- B. Generally, machined and unpainted parts subject to damage by the elements shall be protected with an application of a strippable protective coating.
- C. Equipment shall be packaged or crated in a manner that will provide protection from damage during shipping, handling, and storage.
- D. The outside of the package or crate shall be adequately marked or tagged to indicate its contents by name and equipment number, if applicable, approximate weight, special handling precautions, and recommended storage procedures.

1.04 PACKAGING AND DELIVERY OF SPARE PARTS AND SPECIAL TOOLS

Spare parts and special tools shall be properly marked to identify the associated equipment by name, equipment type, and part number. Parts shall be packaged in a manner for protection against damage from the elements during shipping, handling, and storage. Spare parts and special tools shall be shipped in boxes that shall be marked to indicate the contents. Delivery of spare parts and special tools shall be made prior to the time the associated equipment is scheduled for its initial test run.

1.05 DELIVERY

- A. Arrange deliveries of products to accommodate for short term site completion schedules and in ample time to facilitate inspection prior to installation. Avoid deliveries that cause unnecessarily lengthy use of limited storage space.
- B. Coordinate deliveries to avoid conflict with Work and conditions at the site and to accommodate the following:
 - 1. Work of other contractors or OWNER,
 - 2. Limitations of storage space,
 - 3. Availability of equipment and personnel for handling products,
 - 4. OWNER's use of premises.
- C. Have products delivered to the site in CONTRACTOR's original, labeled containers.

1.06 SHIPMENT AND HANDLING

- A. Shipments shall be addressed to the CONTRACTOR who will be responsible for their receipt, unloading, handling, and storage at the site. The Brownsville Public Utilities Board or OWNER will not accept deliveries on behalf of the CONTRACTOR or his Subcontractors or assume responsibility for the security of the materials, equipment, or supplies delivered to the site.
- B. The CONTRACTOR will transport and handle products in accordance with CONTRACTOR'S instructions. Immediately on delivery, inspect shipments to assure
compliance with requirements of contract documents and approved/accepted submittals, and that products are properly protected and undamaged.

- C. Coordinate the off-loading of materials and equipment delivered to the job site. If necessary to move stored materials and equipment during construction, CONTRACTOR shall relocate materials and equipment at no additional cost to OWNER.
- D. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- 1.07 INSPECTION
 - A. Immediately upon receipt of equipment and materials at the job site, the CONTRACTOR shall inspect for completeness and any evidence of damage. Should there appear to be any damage, the CONTRACTOR shall immediately notify the Construction Observer/Inspector. The CONTRACTOR will then be responsible for notifying the CONTRACTORS and the transportation company of the extent of the damage. If the item or items require replacing, the CONTRACTOR shall take the necessary measures for replacement.
- 1.08 STORAGE AND PROTECTION
 - A. The CONTRACTOR shall store products in accordance with the CONTRACTOR's instructions, with seals and labels intact and legible. Sensitive items shall be stored in weather-tight enclosures; with the humidity and temperature maintained within the ranges recommended by the CONTRACTOR. All materials shall be stored in Cameron County.
 - B. For exterior storage of fabricated products, the CONTRACTOR shall place on sloped supports above ground. Products that are subject to deterioration shall be covered with an impervious sheet and shall be supplied with adequate ventilation to avoid condensation.
 - C. The CONTRACTOR shall store loose granular materials on solid surfaces in a well drained area in such a manner as to prevent mixing.
 - D. The CONTRACTOR shall arrange to provide access for inspection. He shall also periodically inspect to ensure products are undamaged and are maintained under required conditions.
 - E. The CONTRACTOR shall restrict storage to areas available on the construction site for storage of material and equipment as approved by OWNER. If on-site storage is not adequate for the safe and timely storage of material and equipment, the CONTRACTOR shall provide off-site storage.
 - F. The CONTRACTOR shall not use lawns, grass plots or other private property for storage purposes without written permission of the OWNER and other person in possession or control of such premises.
 - G. The CONTRACTOR shall protect stored materials and equipment against loss or damage.

- H. Materials delivered and stored along the line of the Work shall be neatly, safely and compactly stacked along the work site in such manner as to cause the least inconvenience and damage to property owners and the general public, and shall be no closer than three (3) feet to any fire hydrant. Public and private drives and street crossings shall be kept open.
- I. The CONTRACTOR shall repair or replace to the satisfaction of OWNER any damage to lawns, sidewalks, streets or other improvements. The total length which materials may be distributed along the route of construction at any time is one-thousand 1,000 linear feet, unless otherwise approved in writing by OWNER.
- 1.09 INVENTORY CONTROL
 - A. Equipment and materials shall be stored in a manner to provide easy access for inspection and inventory control. The CONTRACTOR shall keep a running account of all materials in storage to facilitate inspection and to estimate progress payments for materials delivered but not installed in the Work.
- 1.10 PRODUCT OPTIONS
 - A. The CONTRACTOR has the following options in providing products specified for the Work:
 - B. Products specified by reference standards or by description only: The CONTRACTOR may provide any product meeting the standard.
 - C. Products specified by naming one or more CONTRACTORS: The CONTRACTOR may provide the product from the named CONTRACTOR or he may submit a request for substitution for any CONTRACTOR not specifically named.
- 1.11 SUBSTITUTIONS
 - A. For a period of up to thirty (30) days after execution of the contract, but no later than the Shop Drawing submittal date, the OWNER will consider written requests from the CONTRACTOR for substitutions. Substitutions will be considered only when a product becomes unavailable due to no fault of the CONTRACTOR or is shown to be superior to the specified product. CONTRACTOR shall reimburse OWNER for time required for review of substitution at a rate of \$180.00/hour with a minimum charge of no less than two (2) hours for each such review.
 - B. The CONTRACTOR shall document each request with complete data substantiating compliance of proposed substitution with the contract documents. Each request constitutes a declaration from the CONTRACTOR that:
 - 1. The CONTRACTOR has investigated the proposed product and determined that it meets or exceeds, in all respects, the specified product.
 - 2. The CONTRACTOR shall provide the same warranty for substitution as for the specified product.
 - 3. The CONTRACTOR shall coordinate installation and make all other changes which may be required for the Work to be complete in all respects.
 - 4. The CONTRACTOR waives claims for additional costs which may subsequently become apparent.

- 5. The CONTRACTOR shall be responsible for the OWNER's cost for review of alternate materials and products.
- 6. Effect on the construction schedule.
- 7. Listing of any required license fee or royalties.
- 8. Availability of maintenance service and source of replacement materials.
- C. Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without a separate written request, or when acceptance will require substantial revision of the contract documents.
- D. OWNER will determine acceptability of proposed substitution, and will notify CONTRACTOR of acceptance or rejection in writing within a reasonable period of time.
- E. Only one (1) request for substitution will be considered for each product. When substitution is not accepted, the CONTRACTOR will provide the specified product.
- 1.12 SYSTEMS DEMONSTRATION
 - A. Prior to final inspection, CONTRACTOR shall demonstrate operation of each system to the OWNER.
 - B. The CONTRACTOR shall instruct the OWNER's personnel in operation, adjustment, and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction.
- PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

EQUIPMENT LIST

PART 1 GENERAL

1.01 SCOPE

- A. This section consists of an equipment schedule for items for which a basic level of CONTRACTOR's field services or operation and maintenance manuals are required, but not covered in other sections. When other sections indicate that CONTRACTOR's field services and operation and maintenance manuals are required, the requirements shall be as specified in the other sections. Specific requirements for CONTRACTOR's field services are covered in the Quality Control section and the equipment specifications. Specific requirements for operation and maintenance manuals are covered in the Submittals section.
- 1.02 RELATED WORK
 - A. Division 15 Mechanical
 - B. Division 16 Electrical
 - C. Division 17 Instrumentation
- 1.03 REFERENCED STANDARDS
 - A. All Standards referenced in the specification sections listed above shall be incorporated into this specification.
- 1.04 SUBMITTALS
 - A. Submittals shall be made in accordance with the requirements of the General Conditions and Division 1 and the applicable sections of these Contract Documents.
- 1.05 PRODUCT DELIVERY AND STORAGE
 - A. Unless noted otherwise, the spare parts shall be delivered to the OWNER prior to final acceptance of the project. Storage of the parts shall be as directed by the OWNER's personnel.

1.06 SCHEDULE

A. CONTRACTOR's field services, including equipment installation checks and training, and operation and maintenance manuals shall be provided for the items of equipment indicated in the following schedule:

Specification Section	Type of Equipment	Certifications	CONTRACTOR's Field Services		
			Training	Testing	O&M Manual
11062	Pumping Equipment	Х	Х	Х	Х
15072	Ductile Iron Pipe and Fittings	х	Х	х	
15206	Check Valves	Х	Х	Х	Х
15207	Plug Valves	Х	Х	Х	Х
16250	Soft Start Controllers	Х	Х	Х	Х
16410	Switches and Breakers	Х	Х	Х	Х
16461	Transformers	Х	Х	Х	Х
16470	Panelboards	Х	Х	Х	Х
16900	Instrumentation/Controls	Х	Х	Х	Х
16950	Field Instruments	X	Х	Х	Х

CONTRACTOR'S FIELD SERVICES

PART 1 GENERAL

- 1.01 SCOPE
 - A. This section shall govern the requirements established for CONTRACTOR's field services associated with the installation of equipment.
- 1.02 RELATED WORK
 - A. Section 01300 Submittals
 - B. Section 01600 Material and Equipment
 - C. Section 01620 Equipment Schedule
 - D. Section 01650 Facility Start Up/Commissioning Requirements
- 1.03 DESCRIPTION OF WORK
- A. CONTRACTOR shall arrange for and coordinate services as specified in the Contract Documents.
- 1.04 SUBMITTALS
 - A. Training Plan (Pre Start Up and Post Start Up):
 - 1. Submit not less than twenty-one (21) calendar days prior to start of equipment testing and revise as necessary for OWNER's acceptance.
 - 2. Submit CONTRACTOR's tentative training schedule, training plan, and contact person not less than sixty (60) calendar days prior to commencement of any training.
 - a. CONTRACTOR's proposed Training Plan shall include the elements presented in the Outline of Instruction Training Plan specified herein. Specific components and procedures shall be identified in the proposed Training Plan. Hands-on demonstrations planned for the instruction shall be described in the Training Plan. The CONTRACTOR shall indicate the estimated duration of each segment of the Training Plan.
 - (i) Outline of Instruction Training Plan:
 - (a) Equipment Description and Purpose
 - (b) Equipment operation
 - (c) Detailed component description
 - (d) Equipment preventative maintenance (PM)
 - (e) Equipment troubleshooting
 - (f) Equipment corrective maintenance
 - 3. Provide complete training materials, to include operation and maintenance data as required in this section to be retained by each trainee.
 - B. Quality Control Submittals:

- 1. CONTRACTOR's Certificate of Proper Installation:
 - a. When specified in the individual equipment specification sections or Equipment Schedule, submit certificate certifying:
 - (i) The product or system has been installed in accordance with the CONTRACTOR's recommendations, inspected by a CONTRACTOR's authorized representative, and serviced with the proper lubricants.
 - (ii) Necessary safety equipment has been properly installed.
 - (iii) Electrical and mechanical connections have been made meeting quality and safety standards as required.
 - (iv) Free from undue stress imposed by exterior connections or loads.
 - (v) Proper adjustments have been made and the product or system is ready for testing, facilities startup, operational test, and operation.
 - b. Submit CONTRACTOR's Certificated of Proper Installation Form at end of this Specification.
- 2. Certificate of Successful Equipment Testing: Prepare and submit where specified in individual equipment specification sections or Equipment Schedule, and upon completion of successful testing of respective equipment by the CONTRACTOR. See Certificate of Successful Equipment Testing Form at end of this Specification.
- 3. Certificate of Successful Equipment System, Subsystem or Component, Start Up Testing including Functional and Performance Tests: Prepare and submit where specified in individual equipment specification sections or Equipment Schedule, and upon completion of successful Start Up testing of respective equipment system, subsystem or component by the CONTRACTOR. See Certificate of Successful Equipment System, subsystem or component Start Up Testing Form at end of this Specification.
- 4. Certificate of qualification of CONTRACTOR's representative.
- 1.05 QUALIFICATION OF CONTRACTOR'S REPRESENTATIVE
- A. Authorized representative of the CONTRACTOR, Certified by CONTRACTOR, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, system, subsystem, or component. Representative subject to acceptance by OWNER. No substitute representatives will be allowed unless prior written approval by OWNER has been given.

1.06 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Where CONTRACTOR's field services are specified, furnish CONTRACTOR's representative qualified to provide these services. Where time is necessary in excess of that stated in the Contract Documents for CONTRACTOR's field services, additional time required to perform the specified services shall be considered incidental work.
- B. Coordinate and Schedule CONTRACTOR's field services to avoid conflicting with other field testing or other CONTRACTOR's field services. Determine that all conditions necessary to allow successful testing have been met before scheduling field services.
- C. Only those days of service approved by OWNER will be credited to fulfill the specified minimum services.
- D. If specified, CONTRACTOR's field services shall include as a minimum:

- 1. Assistance during installation to include observation, guidance, instruction of CONTRACTOR's assembly, erection, installation or application procedures.
- 2. Inspection, checking, and adjustment as required for equipment to function as warranted by CONTRACTOR and necessary to provide written approval of installation.
- 3. Providing on a daily basis, copies of all CONTRACTOR's representatives field notes and data to OWNER.
- 4. Revisiting the site as required to correct problems and until installation and operation are acceptable to OWNER.
- 5. Resolution of assembly or installation problems attributable to, or associated with, respective CONTRACTOR's products, equipment, system, subsystem and components.
- 6. Assistance during testing and Start Up demonstration, and until product acceptance by the OWNER.
- 7. Training of OWNER's personnel in the operation and maintenance of respective products as required herein.
- 8. Completion of CONTRACTOR's Certificate of Proper Installation and applicable certificates of Successful Equipment Testing and Successful Equipment System, Subsystem or Component Start Up Testing, as required, including functional and performance tests service. (Forms at the end of this Specification)

1.07 CONTRACTOR'S CERTIFICATE OF COMPLIANCE

- A. When specified in individual Specification section, submit prior to shipment of product or material.
- B. OWNER may permit use of certain materials or assembles prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Signed by product CONTRACTOR certifying that product or material specified conforms to or exceeds specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to OWNER.
- E. When so specified, a CONTRACTOR's Certificate of Compliance, a copy of which is attached to this section, shall be completed and signed by the equipment CONTRACTOR's representative.
- F. Such form shall certify that the signing party is a duty authorized representative of the CONTRACTOR, is empowered by the CONTRACTOR to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

- 1.08 TRAINING SCHEDULE
 - A. List specified equipment, system, subsystem, and component with respective CONTRACTORS that require training services of CONTRACTOR's representatives and show:
 - 1. Respective CONTRACTOR.
 - 2. Estimated dates for installation completion.
 - 3. Estimate training dates to allow for multiple sessions when several shifts are involved.
 - 4. Use Equipment Schedule as guidance and revise as needed to meet individual equipment specifications or CONTRACTORS' requirements for the preparation of estimated dates. Dates must be included as milestones on general project schedule, and must be coordinated as to allow completion of the project including Start Up Phase by Substantial Completion Date.
 - B. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by OWNER and to allow full participation by CONTRACTOR's representatives. Adjust schedule for interruptions in operability of equipment.
 - C. Training shall not proceed until all individual equipment, systems, subsystems or components have been installed and approved by the CONTRACTOR and completed the testing requirements indicated in Specification Section 01650.
 - D. Pre-Start Up Training:
 - 1. Coordinate and furnish classroom training sessions with the OWNER's operating personnel and CONTRACTOR's representatives.
 - 2. Conduct training at least fourteen (14) days prior to System Start Up as defined in Specification Section 01650.
 - 3. Provide Draft O&M Manuals, in accordance with Specification Section 01830, Operation and Maintenance Data.
 - E. Post Start Up Training:
 - 1. Coordinate and furnish on-site training sessions with the OWNER's operating personnel and CONTRACTOR'S representatives.
 - 2. Conduct after System Start Up, but prior to Operational Testing of the equipment as defined in Specification Section 01650.
 - 3. Provide Final O&M Manuals.
- 1.09 TRAINING OWNER'S PERSONNEL
 - A. Provide trained, articulate personnel acceptable to the OWNER to coordinate and expedite training, to be present during training coordination meetings with OWNER and familiar with operation and maintenance manual information.

- B. CONTRACTOR's Representative shall provide the number of days of training for equipment as indicated in the Equipment Schedule section. Operator training days shall be in addition to CONTRACTOR's field services required as indicated in the Equipment Schedule and submittals sections.
 - 1. All training will be performed during the operating staff's normal business hours and at other times requested and approved by the OWNER.
- C. CONTRACTOR's representatives to provide detailed training to OWNER's personnel on operation and maintenance of specified product (equipment, system, subsystem, component) and as required in applicable Contract Documents. This includes operation, disassembly, and assembly of major equipment items, start up, shutdown, safety concerns, troubleshooting, installation, alignment, and recommended corrective and preventative maintenance procedures for all equipment.
 - 1. Training services include Pre Start Up classroom instruction and Post Start Up onsite hands-on instruction.
 - 2. CONTRACTOR's Representative shall be familiar with system operation and maintenance requirements for specified equipment, system, subsystem, or component.
- D. Lesson Plan: When CONTRACTOR or vendor training of OWNER personnel is specified, prepare for each required course, containing the following minimum information:
 - 1. Title and objectives.
 - 2. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
 - 3. Course description and outline of course content.
 - 4. Format (e.g., lecture, self-study, demonstration, hands-on).
 - 5. Instruction materials and equipment requirements.
 - 6. Resumes of instructors providing the training.
- E. Taping of Training Sessions: CONTRACTOR to videotape Pre Start and Post Start Up training sessions and furnish to the OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

CONTRACTOR'S CERTIFICATE OF PROPER INSTALLATION

BROWNSVILLE PUBLIC UTILITIES BOARD	
EQPT SERIAL NO.:	
EQPTTAGNO.:	EQPT/SYSTEM:
PROJECT NO.:	SPEC. SECTION:

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- □ Installed in accordance with CONTRACTOR's recommendations.
- □ Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.

Comments:_____

I, the undersigned CONTRACTOR's Representative, hereby certify that I am (i) a duly authorized representative of the CONTRACTOR, (ii) empowered by the CONTRACTOR to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the CONTRACTOR is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

CONTRACTOR:_____

— Bv

CONTRACTOR's

Authorized

Representative:

(Print Name/Authorized Signature)

CERTIFICATE OF SUCCESSFUL EQUIPMENT TESTING

BROWNSVILLE PUBLIC UTILITIES BOARD EQPT SERIAL NO.:______EQPT/SYSTEM:______EQPT/SYSTEM:______ PROJECT NO.:______SPEC. SECTION:______

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Serviced for proper operation, efficiency, and capacity.
 - □ Field adjusted for secure satisfactory operation.
- □ Tested continuously under actual or simulated operation conditions.
- □ Tested over the full range of speed and pressure.
 - □ Tested at every level of control.

Comments:_____

I, the undersigned Contractor's Representative, hereby certify that I am (i) a duly authorized representative of the CONTRACTOR, (ii) empowered by the CONTRACTOR to inspect, approve, operate and test his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the CONTRACTOR is successful test and ready for operation, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Contractor:

By CONTRACTOR/Supplier Authorized Representative:

(Print Name/Authorized Signature)

By Contractor's Authorized Representative:

(Print Name/Authorized Signature)

CERTIFICATE OF SUCCESSFUL EQUIPMENT SYSTEM, SUBSYSTEM OR COMPONENT START UP TESTING

BROWNSVILLE PUBLIC UTILITIES BOARD	
EQPT SERIAL NO.:	
EQPTTAGNO.:	EQPT/SYSTEM:
PROJECT NO.:	SPEC. SECTION:

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Demonstrate all operational features, instrumentation, and control functions while in automatic mode.
- Checked for proper installation, started and successfully tested.
- System has been functionally tested and meets or exceeds specified performance requirements. (When complete system of one CONTRACTOR.)
- System has been performance tested and meets or exceeds specified performance requirements. (When complete system of one CONTRACTOR.)
- □ Facility is ready for intended operation.

Comments:

I, the undersigned Contractor's Representative, hereby certify that I am (i) a duly authorized representative of the contractor, (ii) empowered by the CONTRACTOR to inspect, approve, and operate his equipment system, subsystem and (iii) authorized to make recommendations required to assure that the equipment system, subsystem furnished by the CONTRACTOR is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Contractor:

By CONTRACTOR/Supplier Authorized Representative:

(If Required)

(Print Name/Authorized Signature)

By Contractor's Authorized Representative:_

(Print Name/Authorized Signature)

FACILITY STARTUP/COMMISSIONING REQUIREMENTS

- PART 1 GENERAL
- 1.01 SCOPE
 - A. This section covers starting of systems for all items of mechanical, electrical, and control equipment. Additional requirements may be specified in individual equipment section.
 - B. Procedures and actions required of the CONTRACTOR, which are necessary to achieve a Letter of Substantial Completion.
 - 1. Pre Start Up (Construction Phase)
 - a. Factory Tests
 - b. Field Test
 - c. Test Log Submittals
 - 2. System Start Up
 - a. Functional Tests
 - b. Performance Tests
 - C. Procedures and actions required of the CONTRACTOR, which are necessary to achieve a Memo of Final Acceptance.
 - 1. Operational Test
- 1.02 DEFINITIONS
 - A. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of the entire facility or two or more subsystems as well as two or more types of equipment or components.
 - B. Pre Start Up: The period of time of unspecified duration during construction and installation activities which the CONTRACTOR performs the following sequence:
 - 1. Finishes construction work so that the Project has reached a tentative state of Substantial Completion pending completion of the System Start Up.
 - 2. CONTRACTOR's Field Services
 - a. Equipment and Pre Start Up Assistance
 - b. Installation and Equipment Testing Certifications
 - c. Pre Start Up Training, refer to Specification Section 01640 CONTRACTOR's Field Services for videotaping requirements
 - C. System Start Up: A period of time of specified duration, following the Pre-Start Up Period, during which the CONTRACTOR initiates process flow through the facility and operates the facility without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion. The following test activities must be executed by the CONTRACTOR as needed.

- 1. Functional Tests: Test or tests performed by the CONTRACTOR in the presence of the OWNER to demonstrate that installed equipment, system, subsystem or components meet CONTRACTOR's installation and adjustment requirements; and other requirements specified including, but not limited to: noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.
- 2. Performance Test: A test performed by the CONTRACTOR in the presence of the OWNER and after all required functional tests specified, to demonstrate and confirm that the equipment, system, subsystem or components meet the specified performance requirements.
- 3. CONTRACTOR's Field Services
 - a. Equipment and System Start Up Assistance
 - b. Equipment, System, Subsystem, or Component Start Up Testing Certification.
 - c. Post Start Up Training, refer to Specification Section 01640 CONTRACTOR's Field Services for videotaping requirements
- D. Operational Test: A test of specified duration, performed by the OWNER with the assistance of the CONTRACTOR after all System Start Up testing has been completed. The equipment, system, subsystem, or component shall operate continuously without any malfunctions.
- 1.03 SUBMITTALS
 - A. Information Submittals:
 - 1. System Startup and Performance Demonstration Plan.
 - 2. Completed Unit Process Startup Form for each unit process.
 - 3. Completed Facility Performance Demonstration/Certification Form.
 - 4. CONTRACTOR's Certificate of Proper Installation, in accordance with Section 01640 CONTRACTOR's Services, as required by individual specification sections.
- 1.04 SYSTEM STARTUP AND PERFORMANCE DEMONSTRATION PLAN
 - A. Develop a written plan, in conjunction with OWNER's operations personnel to include the following:
 - 1. Step-by-step instructions for startup of each unit process and the complete facility.
 - 2. Unit Process Startup Form (sample attached), to minimally include the following:
 - a. Description of the unit process, including equipment.
 - b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
 - c. Startup requirements for each unit process, including water, power, chemicals, etc.
 - d. Space for evaluation comments.
 - 3. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
 - a. Description of unit processes included in the system startup.
 - b. Sequence of unit process startup to achieve system startup.
 - c. Description of computerized operations, if any, included in the system.

- d. CONTRACTOR certification system is capable of performing its intended function (s), including fully automatic operation.
- e. Signature spaces for CONTRACTOR and OWNER.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION
- 3.01 DESCRIPTION OF WORK
 - A. All items of mechanical and electrical equipment shall be tested for proper operation, efficiency, and capacity. All required adjustments, tests, operation checks, and other Pre Start Up activity shall be provided.

3.02 PRE START UP (CONSTRUCTION PHASE)

- A. Factory tests
 - 1. All items of equipment so specified shall be tested at the point of MANUFACTURE facility at the CONTRACTOR's expense. Not less than seven (7) certified copies of the test results shall be submitted for review.
 - 2. Coordinate with the OWNER for factory test schedule, if witness testing of equipment is specified in individual specification of the equipment.
 - 3. Equipment shall not be shipped until the OWNER has reviewed the test results and notified the CONTRACTOR in writing that the equipment is acceptable for shipment. Such acceptance, however, shall not be considered as final acceptance, which will only be made on the basis of the test results of the equipment after installation.
- B. Field tests
 - 1. All items of mechanical, electrical, and control equipment shall be tested by the CONTRACTOR after installation for proper operation, efficiency, and capacity. The CONTRACTOR's test operation of each piece of equipment shall continue for not less than eight (8) hours without interruption. All moving parts of equipment and machinery shall be carefully tested for operation, and adjusted so all parts move freely and function to secure satisfactory operation. All parts shall operate satisfactorily in all respects, under continuous full load and in accordance with the specified requirements, for the full duration of the eight-hour test period. If necessary, corrections or repairs shall be made and the full eight-hour test operation, as specified, shall be completed after all parts operate satisfactorily.
 - 2. The CONTRACTOR shall furnish and pay for all power, water, fuels, oil, grease, chemicals, and auxiliaries that are required for conducting the CONTRACTOR's testing of the equipment for proper operation, efficiency, and capacity during Pre Start Up.
 - 3. Field Tests of all process and pumping equipment, drive motors, including auxiliaries shall be made in accordance with the appropriate and approved test codes of the American Society of Mechanical Engineers (ASME), Hydraulic Institute Standards, National Electrical CONTRACTORs Association (NEMA), and Institute of Electrical and Electronics Engineers (IEEE).

- 4. Field testing shall be conducted before the Work is ready for System Start Up and is substantially complete so each item of equipment is ready for integrated operation with other equipment at the facility. Testing, measuring, and calibrating procedures shall be submitted to the OWNER for review and acceptance prior to field testing of equipment. The facility control system must be in place and CONTRACTOR's Certificate of Proper Installation must be completed prior to equipment tests.
- 5. All equipment shall be tested continuously under actual or simulated operating conditions. Equipment shall be tested over the full range of speed, capacity and pressure. Equipment shall also be tested at every level of control. Valves shall be throttled as required to simulate the full operating range. Curves shall be developed from the test data and compared to the specified performance criteria. The CONTRACTOR shall provide all appurtenances as required, but not limited to flow meters for liquid and gas flow pressure gauges and throttling valves, to verify performance. The CONTRACTOR shall be fully responsible for the operation and maintenance of the equipment during Pre Start Up. During testing, pressure, flow rate, amperage, voltage, vibration, equipment temperature, ambient temperature, tank level and the level of all water surfaces shall be measured. The CONTRACTOR's representative shall make all necessary field adjustments and correct defects in materials or workmanship during this test period. The equipment shall be properly filled, by the CONTRACTOR, with oil and grease.
- 6. The period of inspection, Pre Start Up operation, and field adjustment shall be as required to achieve satisfactory installation and operation of the items furnished.
- C. Test log submittals
 - 1. CONTRACTOR's Certificate of Proper Installation Utilize the CONTRACTOR's Certificate of Proper Installation Form from Section 01640 CONTRACTOR's Field Services, supplemented as necessary, to document results, problems, and conclusions.
 - 2. Equipment Test Test report and certification of test for each piece of equipment, system, subsystem, or component specified. See Section 01640.
 - 3. I/O Loop Test Third Party Independent Test Agency
 - 4. Equipment Calibration Sheets Certifications of calibration for testing equipment and permanent equipment.
 - 5. Electrical Testing Third Party Independent Test Agency
 - 6. Certificate of Successful Equipment Testing Utilize the Certificate of Successful Equipment Testing Form from Section 01640 CONTRACTOR's Field Services, supplemented as necessary, to document results, problems, and conclusions.
- D. Additional pre start up activities
 - 1. General activities include
 - a. Cleaning.
 - b. Removing temporary protective coatings.
 - c. Flushing and replacing greases and lubricants, where required by the CONTRACTOR.
 - d. Lubrication.
 - e. Check shaft and coupling alignments and reset where needed.

- f. Check and set motor, pump and other equipment rotation, safety interlocks, and belt tensions.
- g. Check and correct if necessary leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on pumping equipment connected to it.
- h. All adjustments required.
- 2. Minimum activities include
 - a. Bearings and Shafts
 - (i) Inspect for cleanliness, clean and remove foreign materials.
 - (ii) Verify alignment.
 - (iii) Replace defective bearings, and those which run rough or noisy.
 - (iv) Grease as necessary, in accordance with CONTRACTOR's recommendations.
 - b. Drives
 - (i) Adjust tension in V-belt drives, and adjust vari pitch sheaves and drives for proper equipment speed (if necessary).
 - (ii) Adjust drives for alignment.
 - (iii) Clean and remove foreign materials before starting operation.
 - c. Motors
 - (i) Check each motor for comparison to amperage nameplate value.
 - (ii) Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.
 - (iii) Check each motor for proper rotation.
 - d. Pumps
 - (i) Check glands and seals for cleanliness and adjustment before running pump.
 - (ii) Inspect shaft sleeves for scoring.
 - (iii) Inspect mechanical faces, chambers, and seal rings, and replace if defective.
 - (iv) Verify that piping system is free of dirt and scale before circulating liquid through the pump.
 - e. Valves
 - (i) Open and close valves by hand and operate to check for binding, interference, or improper functioning.
 - (ii) Inspect both manual and automatic control valves, clean bonnets and stems.
 - (iii) Tighten packing glands to assure no leakage, but permit valve stems to operate without galling.
 - (iv) Replace packing in valves to retain maximum adjustment after system is judged complete.
 - (v) Replace packing on any valve which continues to leak.
 - (vi) Remove and repair bonnets which leak.
 - (vii) Coat packing gland threads and valve stems with an appropriate surface preparation after cleaning.
 - f. Verify that control valve seats are free from foreign material, and are properly positioned for intended service.
 - g. Tighten all pipe joints after system has been field tested. Replace gaskets which show any sign of leaking after tightening.
 - h. Inspect all joints for leakage.
 - i. Promptly remake each joint which appears to be faulty, do not wait for rust to form.

- j. Clean threads on both parts, apply compound and remake joints.
- k. Clean strainers, dirt pockets, orifices, valve seats, and headers in fluid system, to assure freedom from foreign materials.
- I. Open traps and air vents where used, remove operating elements. Clean thoroughly, replace internal parts and put back in readiness mode.
- m. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
- n. Set and calibrate permanent equipment.
- o. Check each electrical control circuit to assure that operation complies with Contract Documents and requirements to provide desired performance.
- p. Inspect each pressure gage and thermometer for calibration. Replace items which are defaced, broken, or which read incorrectly.
- q. Repair damaged insulation.
- r. Vent gases trapped in any part of systems. Verify that liquids are drained from all parts of gas or air system.
- s. Calibrate testing equipment for accurate results.
- t. Check power supply to electric-powered equipment for correct voltage.
- u. Adjust clearances and torque.
- v. Test piping for leaks.
- w. Equipment and electrical tagging complete.
- x. All spare parts and special tools delivered to OWNER.
- 3.03 SYSTEM START UP
 - A. Submittals
 - 1. Administrative Submittals.
 - a. Functional and Performance test schedules.
 - b. Plan for equipment, systems, subsystem, or component at least twenty-one (21) calendar days prior to start of related testing. Include test plan, procedures, and log format.
 - c. Schedule and plan of System Start Up activities at least thirty (30) calendar days prior to commencement.
 - Certificate of Successful Equipment, System, Subsystem, or Component Start Up Testing – Utilize the Certificate of Successful Equipment, system, subsystem, or component Start Up Testing Form from Section 01640 – CONTRACTOR's Field Services, supplemented as necessary, to document functional and performance procedures, results, problems, and conclusions.
 - B. Contractor facility start up responsibilities
 - 1. General
 - a. Prepare and pretest all equipment insofar as possible to check its ability for sustained operation, including inspections and adjustments by CONTRACTOR's servicemen.
 - b. Be responsible for System Start Up of all facilities constructed under this Contract.
 - c. Perform Work for tests specified.
 - d. Demonstrate proper installation, adjustment, function and performance of equipment, systems, subsystem, or components, control devices, and required interfaces individually and in conjunction with process instrumentation and control system.

- e. The CONTRACTOR shall furnish and pay for all power, water, fuels, oil, grease, chemicals, and auxiliaries that are required for conducting the CONTRACTOR's testing of the equipment for proper operation, efficiency, and the capacity during System Start Up.
- C. Owner's facility startup responsibilities
 - 1. General
 - a. Review CONTRACTOR's test plan and schedule.
 - b. Witness each functional and performance tests.
 - c. Provide assistance and support for start up and performance testing.
 - d. OWNER will operate portion of facilities not part of the construction contract.
- D. Testing preparation
 - 1. General.
 - a. Complete Work associated with the equipment, system, subsystem, or components and related processes before testing, including related CONTRACTOR's representative services.
 - b. Furnish qualified CONTRACTOR's representatives when required to assist in testing.
 - c. Utilize the Certificate of Successful Equipment, System, Subsystem or component Start Up Testing Form from Section 01640 – CONTRACTORs Field Services, supplemented as necessary, to document functional and performance procedures, results, problems, and conclusions.
 - d. Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, OWNER involvement.
 - e. Designate and furnish one or more persons to be responsible for coordinating and expediting CONTRACTOR's System Start Up duties. The person or persons shall be present during System Start Up meetings and shall be available at all times during the System Start Up period.
 - f. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.
 - 2. Cleaning and Checking: Prior to starting functional testing.
 - a. Calibrate testing equipment for accurate results.
 - b. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
 - c. Lubricate equipment in accordance with CONTRACTOR's instructions.
 - d. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
 - e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - f. Check power supply to electric-powered equipment for correct voltage.
 - g. Adjust clearances and torque.
 - h. Test piping for leaks.
 - i. Obtain completion of applicable portions of CONTRACTOR's Certificate of Proper Installation in accordance with Section 01640 – CONTRACTORs Field Services.
 - 3. Ready-to-test determination will be by OWNER based at least on the following:

- a. Notification by CONTRACTOR of equipment and system readiness for testing.
- b. Acceptable Test Log Submittal to OWNER.
- c. Acceptable testing plan.
- d. Acceptable Final Draft Operation and Maintenance Manuals.
- e. Receipt of CONTRACTOR's Certificate of Proper Installation, as required.
- f. Receipt of Certificate of Successful Equipment Testing, as required.
- g. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
- h. Availability and acceptability of CONTRACTOR's representative, when specified, to assist in testing of respective equipment, and satisfactory fulfillment of other specified CONTRACTORs' responsibilities.
- i. Equipment and electrical tagging complete.
- j. All spare parts and special tools delivered to and become property of the OWNER.
- E. Functional test-general
 - 1. Begin testing at a time mutually agreed upon by the OWNER and CONTRACTOR.
 - 2. OWNER and CONTRACTOR's Representative will be present during test. Notify in writing CONTRACTOR's representative(s) at least twenty-one (21) calendar days prior to scheduled date of functional tests.
 - 3. Separate items of equipment demonstrated to function properly during subsystem testing may require no further Functional test if documentation of subsystem testing is acceptable to OWNER.
 - 4. Conduct functional tests as specified for each equipment, system, subsystem, on component for a minimum period of eight (8) hours.
 - 5. Demonstrate all operational features and instrumentation and control functions while in automatic mode.
 - 6. If, in OWNER's opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.
 - 7. Performance testing shall not commence until the equipment, system, subsystem, or components meets the specified functional tests.
- F. Performance test-general
 - 1. Begin testing at a time mutually agreed upon by the OWNER and CONTRACTOR.
 - 2. OWNER will be present during test. Notify in writing CONTRACTOR's Representative(s) at least twenty-one (21) days prior to scheduled date of performance tests.
 - 3. Conduct performance tests as specified for each equipment, system, subsystem, or component for a minimum period of one (1) day.
 - 4. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.

- 5. Prepare performance test report summarizing test method. Include test logs, pertinent calculations, and CONTRACTOR's Certificate of Successful Equipment, System, Subsystem, or Component Start Up Testing.
- G. System start up test period
 - 1. General.
 - a. Attend planning meetings and arrange for attendance by key major equipment CONTRACTOR representatives as required by the Contract Documents.
 - b. Designate one or more persons on the CONTRACTOR's staff to be able for coordinating and expediting CONTRACTOR's System Start Up duties.
 - c. When System Start Up has commenced, schedule remaining Work so as not to interfere with or delay the completion of System Start Up.
 - d. Support System Start Up activities with adequate staff to prevent delays. Such staff shall include, but not be limited to, equipment, system, subsystem, or component, CONTRACTOR's representatives, electricians, instrumentation and control personnel, millwrights, pipe fitters, and plumbers.
 - e. Furnish and coordinate specified CONTRACTOR's System Start Up services.
 - 2. System Start Up Testing.
 - a. System Start Up of the entire system or any portion thereof requires the coordinated operation of the facilities by the CONTRACTOR, SUBCONTRACTORs, OWNER's operating personnel, and CONTRACTOR's representatives.
 - b. System Start Up of the entire facility or any portion thereof shall be considered complete when, in the opinion of the OWNER, the facility or designated portion has operated in the manner intended without interruption as specified in Paragraph 3.04 of this section. This includes any training, functional or performance test periods specified herein.
 - c. An interruption may include but is not limited to any of the following events.
 - (i) Failure of CONTRACTOR to maintain qualified onsite System Start Up personnel as scheduled.
 - (ii) Failure to meet specified functional or performance tests.
 - (iii) Failure of any critical equipment, system, subsystem or component that is not satisfactorily corrected within two (2) hours after failure.
 - (iv) Failure of any non-critical equipment, system, subsystem, component that is not satisfactorily corrected within eight (8) hours after failure.
 - (v) As may be determined by OWNER.
 - d. An interruption will require the System Start Up, then in progress, to be stopped and restarted after corrections are made.
 - 3. Startup Test Reports: As applicable to the equipment furnished, certify in writing that:
 - a. Hydraulic structures, piping systems, and valves have been successfully tested. Equipment, systems, subsystems, or component have been checked for proper installation, started, and successfully tested to indicate that they are operational.
 - b. Equipment, systems, subsystems, or components are capable of performing their intended functions, including fully automatic.
 - c. Facilities are ready for intended operation.
 - d. Final O&M Manuals have been submitted and approved by OWNER.

3.04 OPERATIONAL TEST

- A. As a condition of Final Acceptance, after all functional and performance tests and the entire system is safe and ready to operate, the OWNER will test all constructed facilities using all specified systems in combination with each other for a period of thirty (30) days continuous operation (either actual or simulated) without interruption due to malfunctions of constructed facilities. All defects of material or workmanship which appear during this test period shall be corrected by the CONTRACTOR. After such corrections are made, the thirty (30) day test shall be restarted at zero and run again before final acceptance of the equipment. The time need not be continuous based on malfunctions of associated existing facilities.
- B. The OWNER will supply all power, water, oil, fuels, grease, auxiliaries, and operating personnel required for this final operational test. Contractor shall be responsible supplying chemical throughout the duration of the thirty (30) day operational test period.
- C. Each CONTRACTOR who furnishes equipment that requires factory trained service personnel shall adjust the equipment until the operational tests have been met and the results of the operational tests have been accepted by the OWNER.

3.05 SUPPLEMENTS

- A. Supplements listed below, following "END OF SECTION", are part of the Specification:
 - 1. Unit Process Startup Form
 - 2. Facility Performance Demonstration/Identification Form

UNIT PROCESS STARTUP FORM

OWNER:	PROJECT:	
Unit Process Description devices):	n: (Include description and equipment number of a	all equipment and
Startup Procedure (Desc be opened/closed, order	cribe procedure for sequential startup and evaluat r of equipment startup, etc.):	tion, including valves to
Startup Requirements (V	Nater, power, chemicals, etc.):	
Evaluation Comments:_		
CONTRACTOR Certifica	tion that Unit Process is capable of performing its	s intended function(s):
CONTRACTOR:	Date:	, 20
Owner: (Authorized Signature	Date:	, 20

SYSTEM PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER:	PROJECT:			
Unit Processes Description (List unit processes involved in facility startup):				
Unit Processes Startup Sequence (Describe sequence) operations, if any):	ence for startup, including, computerized			
CONTRACTOR Certification that Facility is capab including fully automatic operation:	le of performing its intended function(s),			
CONTRACTOR: 20	Date:,			
Owner: (Authorized Signature)	, 20			

CLEANING AND ADJUSTING

PART 1 GENERAL

1.01 RESPONSIBILITY

- A. The CONTRACTOR is responsible for cleaning and adjusting the Work. If the CONTRACTOR fails to clean and adjust the Work, the OWNER may do so and charge the resulting costs to the CONTRACTOR.
- B. Detailed cleaning and adjusting requirements for specific trades or Work are specified in sections pertaining to that trade or Work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Fire Protection:
 - 1. Dispose of volatile waste in suitable covered metal containers and remove from premises daily.
 - 2. Store volatile materials in safe metal containers.
 - 3. Submit temporary facility plan showing location of volatile waste and material storage areas.
- B. Pollution Control: Conduct cleaning and disposal operations in compliance with local ordinances and antipollution laws.
 - 1. Burning or burying of rubbish and materials on the Project site is not permitted.
 - 2. Disposal of volatile fluid wastes and other chemical wastes in storm or wastewater systems or into streams or waterways is not permitted.
- C. Safety Standards: Maintain the Project in accordance with insurance and safety standards.
- PART 2 PRODUCTS
- 2.01 GENERAL

Use only cleaning materials recommended by the CONTRACTOR of the surface to be cleaned. Employ cleaning materials as recommended by the cleaning material CONTRACTOR.

- PART 3 EXECUTION
- 3.01 DURING CONSTRUCTION
 - A. Clean and ensure that the premises are maintained free from accumulations of waste material and rubbish. Do not allow waste materials, rubbish and debris to accumulate and become unsightly or create a hazard. Dispose of materials in an approved receptacle daily in accordance with applicable federal, state, and local regulations.

- B. At least weekly during progress of the Work or at the direction of the OWNER, remove collected waste material, rubbish and debris from the site. Handle waste in a controlled manner; do not drop or throw materials from heights.
- C. At least weekly during the progress of the Work or at the direction of the OWNER, mow the area surrounding OWNER's and CONTRACTOR's construction trailer, staging area site and OWNER'S construction area.
- 3.02 FINAL CLEANING AND ADJUSTING
 - A. At the completion of Work and immediately prior to final inspection, cleaning of the entire Project shall be accomplished according to the following provisions:
 - 1. The CONTRACTOR shall thoroughly clean, sweep, wash and polish all Work and equipment provided under the contract, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the OWNER.
 - 2. The CONTRACTOR shall remove all temporary structures and all debris, including all dirt, sand, gravel, rubbish and waste material. See Section 01500 Construction Facilities and Temporary Controls.
 - 3. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.
 - B. Employ experienced workers, or professional cleaners, for final cleaning.
 - C. Use only cleaning materials recommended by CONTRACTOR of surface to be cleaned and only on surfaces recommended by cleaning material CONTRACTORS.
 - D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
 - E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.
 - F. Repair, patch and touch up marred surfaces to specified finish, to match adjacent surfaces.
 - G. Replace air handling filters if units were operated during construction.
 - H. Clean ducts, blowers, and coils, if air handling units were operated without filters during construction.
 - I. Vacuum clean all interior spaces, including inside cabinets. Broom clean paved surfaces, rake clean other surfaces of grounds.
 - J. Schedule cleaning operations so that dust and other containments resulting from cleaning process will not fall on wet, newly painted surfaces.

3.03 ADJACENT AREAS

A. To the OWNER'S satisfaction, clean or repair adjacent areas affected by the construction. Remove dust and debris in the adjacent area. Repair, patch and touch-up marred surfaces to match adjacent finishes.

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall maintain and provide the OWNER with Project record documents as specified below.
- B. Maintenance of Documents
 - 1. Maintain in CONTRACTOR's field office in clean, dry, legible condition complete sets of the following: contract drawings, specifications, addenda, approved/accepted shop drawings, samples, photographs, change orders, other modifications of contract, test records, survey data, field orders, and all other documents pertinent to CONTRACTOR's Work.
 - 2. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI) unless otherwise approved by OWNER.
 - 3. Make documents available at all times for inspection by OWNER.
 - 4. Record documents shall not be used for any other purpose and shall not be removed from the office without OWNER's approval.
- C. Recording
 - 1. Label each document "Project Record" in 2-inch high printed letters.
 - 2. Keep record documents current and updated at least weekly.
 - 3. Do not permanently conceal any Work until required information has been recorded.
 - 4. Contract Drawings Legibly mark to record actual construction including:
 - a. Depths of various elements of manhole foundation in relation to datum.
 - b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 - c. Field changes of dimensions and details.
 - d. Changes made by change order or field order.
 - e. Details not on original contract drawings.
 - f. Changes of different method of construction.
 - g. Use of different products not specified
 - 5. Specifications and Addenda Legibly mark up each section to record:
 - a. CONTRACTOR, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - b. Changes made by change order or field order.
 - c. Other matters not originally specified.
 - 6. Shop Drawings Maintain as record documents and legibly annotate drawings to record changes made after review.

- 7. Record documents are subject to review by the OWNER on a monthly basis and failure to keep documents accurate and current will be basis for the OWNER to withhold the CONTRACTOR's monthly payment in partial or full.
- D. Record Drawings
 - 1. Record drawings shall reflect completion of the installation of all equipment, piping, and other Work by the CONTRACTOR. The drawings shall show the Work in plan and sections as required for clarity with reference dimensions and elevations for complete record drawings. The drawings shall be furnished not later than thirty (30) days after completion of the Work and prior to final payment.
 - 2. The contract drawings may be used as a starting point in developing these drawings. Subcontractor and CONTRACTOR drawings may be included in this drawing package. The drawing package must be fully integrated and include the necessary cross references between drawings. The drawing package shall include interconnection, numbering, and termination details to equipment furnished under this contract.
 - 3. Electrical as-built drawings shall include at least the following: actual conduit and duct bank routing, terminal strip number references, actual score size and location of electrical equipment and boxes, revision of conduit size wiring, revisions to circuit numbers, and cross references to equipment O&M Manuals.
- E. Submittal
 - 1. At Project completion, deliver record documents to the OWNER. Place all lettersized material in a three (3) ring binder which is neatly indexed by process and division number. Bind contract drawings and shop drawings in rolls of convenient size for ease of handling.
 - 2. Accompany the submittal with a transmittal letter in duplicate containing the following:
 - a. Date.
 - b. Project title and number.
 - c. CONTRACTOR's name and address.
 - d. Title and number of each record document.
 - e. Certification that each document as submitted is complete and accurate.
 - f. Signature of CONTRACTOR.
- F. Preparation of Final Record Drawings
 - 1. The final record drawings will be prepared based upon information provided by the CONTRACTOR. In the preparation of the final drawings any information found lacking or inconsistent shall be corrected by the CONTRACTOR. CONTRACTOR shall have OWNER review and acceptance/approval prior to completion.

WARRANTIES

PART 1 GENERAL

1.01 SCOPE SUMMARY

A. This section specifies general administrative and procedural requirements for warranties required by the Contract Documents, including CONTRACTOR's standard warranties on products and special warranties.

1.02 SUBMITTAL REQUIREMENTS

- A. Submit written warranties to the OWNER prior to the date fixed by the OWNER for Substantial Completion. Warranty duration shall meet the requirements described in the General Conditions. No variations in warranty duration will be allowed.
- B. Assemble warranties, service, and maintenance contracts, executed by each of the respective CONTRACTORs, suppliers, and subcontractors.
- C. Number of original signed copies required: Two (2) each.
- D. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.
 - 1. Product or work item.
 - 2. Firm, with name of principal, address and telephone number.
 - 3. Scope.
 - 4. Date of beginning of warranty, service, or maintenance contract.
 - 5. Duration of warranty, or service maintenance contract.
 - 6. Provide information for OWNER's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances which might affect the validity of warranty.
 - 7. Contractor, name of responsible principal, address and telephone number.
- 1.03 FORMS OF SUBMITTALS
 - A. Prepare in duplicate packets.
 - B. Format:
 - Size 8-1/2 x 11 inches, punch sheets for standard 3-post binder.
 a. Fold larger sheets to fit into binders.
 - Cover: Identify each packet with typed or printed title "WARRANTIES". List:
 a. Title of Project.
 - b. Name of Contractor.
 - 3. Binders: Commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of 2 inches.

1.04 WARRANTY SUBMITTAL REQUIREMENTS

- A. For all major pieces of equipment, submit a warranty from the equipment MANUFACTURER. The MANUFATURER's warranty period shall be as specified in the General Conditions.
- B. The CONTRACTOR shall be responsible for obtaining certificates for equipment warranty for all equipment specified under Divisions 11, 12, 15, 16, 17 for a period of two (2) years.
- 1.05 WARRANTY REQUIREMENTS
 - A. Related Damages and Losses:
 - 1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
 - B. Reinstatement of Warranty:
 - 1. When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 - C. Replacement Cost:
 - 1. Upon determination that work covered by a warranty has failed, replace, or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The CONTRACTOR is responsible for the cost of replacing or rebuilding defective work regardless of whether the OWNER has benefited from use of the work through a portion of its anticipated useful service life.
 - D. OWNER's Recourse:
 - 1. Written warranties made to the OWNER are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the OWNER can enforce such other duties, obligations, rights, or remedies.
 - E. Rejection of Warranties:
 - 1. The OWNER reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
 - F. OWNER's right to Refuse Work:
 - 1. The OWNER reserves the right to refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.
 - G. Disclaimers and Limitations:

1. CONTRACTOR's disclaimers and limitation on product warranties do not relieve the CONTRACTOR of the warranty on the work that incorporates the products, nor does it relieve suppliers, CONTRACTORs and subcontractors required to countersign special warranties with the CONTRACTOR.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION - NOT USED

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittal requirements for manufacturers' operation and maintenance (O&M) manual.
- B. Submittal requirements for O&M manuals.

1.02 REQUIREMENTS

- A. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance information shall be supplied for all equipment requiring maintenance or other attention. Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the equipment schedule.
- B. Operation and maintenance manuals shall include the following:
 - 1. Equipment function, normal operating characteristics, and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
 - 4. Lubrication, maintenance, calibration and testing instructions.
 - 5. Guide to troubleshooting.
 - 6. Parts lists and predicted life of parts subject to wear. Parts list shall include stock numbers, and name, address and phone number of nearest supplier.
 - 7. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
 - 8. Test data and performance curves, where applicable.
 - 9. Complete list of equipment supplied, serial numbers, and CONTRACTORS standard data.
 - 10. Process and Instrumentation diagrams, where applicable.
- C. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by the CONTRACTOR.

1.03 QUALITY ASSURANCE

A. Manuals for equipment and systems shall be prepared by Equipment CONTRACTOR or system supplier. Manuals for materials and finishes shall be prepared by the materials and finishes CONTRACTOR.

1.04 SEQUENCING AND SCHEDULING

- A. Manual Outline: Submit detailed outline of each manual prior to preparation of preliminary manuals.
- B. Manuals for Equipment and Systems.
 - 1. Preliminary Manuals: Submit prior to shipment date for equipment, system, subsystem, or component. Include copy of warranties, Bonds, and service agreements if specified.
 - 2. Final Manuals: Submit not less than thirty (30) days prior to equipment or system field testing or startup.
 - 3. Final Manuals: Submit at least thirty (30) calendar days prior to request for final inspection.
- 1.05 GENERAL
 - A. Furnish for each item of equipment or system as specified in the individual specification sections.
 - B. Prepare data for use by OWNER's personnel in the form of an instructional manual and on electronic media. Data for electronic media shall be provided to OWNER on optical compact disk.
 - C. Paper Format.
 - 1. In cases where multiple equipment is provided by one specification section, provide a fly-leaf for each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment and provide with heavy section dividers with numbered plastic index tabs or permanently labeled tabs.
 - 2. Assemble and bind material by specification section.
 - 3. Each manual shall have original materials. Fax copies or photocopies of CONTRACTOR information will not be accepted.
 - 4. Binders.
 - a. Preliminary Manuals: Heavy paper covers.
 - b. Final Manuals: Commercial quality, substantial, permanent, three (3) ring binders with durable, cleanable, plastic covers.
 - 5. Cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE MANUAL, VOLUME NO. OF -", if applicable, and list:
 - a. Project title.
 - b. Identity of equipment number and Specification section.
 - c. Identity of separate structure as applicable.
 - d. Designate the system or equipment for which it is intended.
 - 6. Text
 - a. Paper Size: 8-1/2-inch by 11-inch. Drawings may be 11-inch by 17-inch.
 - b. Paper type: 20-pound minimum, white for typed pages, with reinforced edge for hole punching.
 - c. CONTRACTOR'S printed data, or neatly typewritten.

- d. Three (3) hole punch paper, arrange printing so that punched holes do not obliterate data.
- e. Provide each manual with title page, table of contents with consecutive page numbers, and text and drawing pages with consecutive numbering. Place contents of entire set, identified by volume number, in each binder.
- f. Table of contents neatly typewritten, arranged in a systematic order. The table of contents shall include but not be limited to the following:
 - (i) CONTRACTOR, name of responsible principal, address, and telephone number.
 - (ii) List by equipment, system, or product the: Subcontractor, supplier, installer, or Maintenance CONTRACTOR name, address, and telephone number.
 - (a) Identify area of responsibility of each.
 - (b) Provide local source of supply for parts and replacement. Identify each product, by product name and other identifying numbers or symbols as set forth in Contract Documents.
- g. List of each equipment and support products required and the product data.
 - (i) Include only those sheets that are pertinent to specific product.
 - (ii) Clearly annotate each sheet to:
 - (a) Identify specific product or part installed.
 - (b) Identify data applicable to installation.
 - (c) Delete references to non-applicable information.
- 7. Drawings: Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - c. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
 - d. Identify Specification section and product on drawings and envelopes.
 - e. Provide reinforced punched binder tab, bind in with text.
 - f. Reduced to 8-1/2-inch by 11-inch, or 11-inch by 17-inch folded to 8-1/2-inch by 11-inch.
 - g. Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
 - h. Do not use Project record documents as maintenance manual drawings.
- 8. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Handling, storage, maintenance during storage, assembly, erection, installation, adjusting, testing, operating, shutdown in emergency, troubleshooting, maintenance, interface, and as may otherwise be required.
 - b. Organize in a consistent format under separate heading for each different procedure.
 - c. Provide a logical sequence of instructions for each procedure. See Paragraphs 1.07 and 1.08 of this section for additional details.
 - d. Provide information sheet for OWNER's personnel, including:
 - (i) Proper procedures in the event of failure.
 - (ii) Instances that might affect the validity of warranties or bonds.
- 9. Air and water balance reports.
- 10. Certificates.
- 11. Warranties, Bonds, and Service Agreements. Include a separate tab and list in the table of contents
- D. Electronic Format: Submit the final O&M manual to OWNER using an optical compact disk formatted for an IBM PC or compatible. Files to be exact duplicates of OWNER-accepted preliminary data, arranged by specification number and name. The following describes the electronic format submittal.
 - 1. The acceptable format is portable document format (PDF): <u>Bluebeam Revu</u> version 20 or higher.
 - 2. The initial filename for the O&M submittal is provided with the request for final O&M manuals. <u>The filename is posted near the top of the Review Form.</u> Filenames use the "eight dot three" convention (XXXXX_YY.PDF) where XXXXX is the specification section number and YY is an ID number. If technical problems require you to break the submittal into more than one file then add a letter extension to the end of each filename. (example: 19876_01A.PDF) Keep the number of files to a minimum.
 - 3. Scan images at a resolution of 300 dpi or greater. Perform Optical Character Recognition (OCR) capture on all images. Achieve OCR with the "*original image with hidden text*" option as seen in Adobe Acrobat Exchange 4.05.
 - 4. Create one PDF document (PDF file) for each equipment service manual. The entire manual is converted to a single PDF file via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the one PDF document. Rotate pages that must be viewed in landscape to the appropriate position for easy reading. <u>Word searches of the PDF document must operate successfully</u> (proof of OCR).
 - 5. Create a bookmark for each major entry ("Chapter", "Section". "Sub-section") in the table of contents, in the navigation frame.
 - a. Generate thumbnails for each PDF file.
 - b. Set the opening view for PDF files as follows: Initial View: Bookmarks an Page Magnification: Fit in Window
 - c. Open to the cover page of the manual, with bookmarks to the left, and the first bookmark linked to the table of contents.
 - d. Labeling: As a minimum requirement include the following labeling on all final O&M materials, including CD-ROM discs and jewel cases or thumb drives .
 (i) CONTRACTOR Name
 - (i) CONTRACTOR Name
 - (ii) Equipment name and/or O&M title spelled out in complete words. (example "Operations and Maintenance Manual", "Oscillating Wastewater Converter")
 - (iii) Specifications Section Number
 - (iv) Include Project name

1.06 SUBMITTAL PROCEDURE

- A. Within one (1) month prior to placing the equipment or facility in service, submit two (2) copies of operation and maintenance manual and parts manual for review.
- B. Preliminary Manuals.

- 1. Submit six (6) copies for OWNER's review.
- 2. Disposition: In accordance with Section 01300 Submittals.
- 3. If accepted:
 - a. One (1) copy will be returned to CONTRACTOR.
 - b. Five (5) copies will be retained in OWNER's file.
- 4. If rejected:
 - a. Five (5) copies will be returned to CONTRACTOR with OWNER's comments for revision.
 - b. One (1) copy will be retained in OWNER's file.
 - c. Resubmit Six (6) copies revised preliminary copies for OWNER's review.
- 5. Submit one (1) preliminary electronic PDF version of O&M manual.
- C. Submit one (1) copy of completed volumes in final form ten (10) days prior to final inspection. This copy will be returned after final inspection, with OWNER comments. Revise content of documents as required prior to final submittal.
- D. Revise and resubmit final volumes within ten (10) days after final inspection.
- E. Final Manuals.
 - 1. If different than accepted preliminary manuals, submit:
 - a. Six (6) copies of any necessary supplemental material, including revised table of contents.
 - b. Instructions for insertion of supplemental material in unreturned sets.
 - 2. Submit Six (6) additional copies of final manual.
 - 3. If final manuals are acceptable, CONTRACTOR will be so notified.
 - 4. If rejected, and at OWNER's option:
 - a. All copies will be returned to CONTRACTOR for revision, or;
 - b. All copies will be retained by OWNER and the necessary revision data will be requested from CONTRACTOR.
 - 5. Submit one (1) final electronic PDF version of O&M manual.

1.07 MANUALS FOR EQUIPMENT AND SYSTEMS

- A. Content for Each Unit (or Common Units) and System.
 - 1. Description of unit and component parts, including controls, accessories, and appurtenances.
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - 2. Operating Procedures.
 - a. Startup, break-in, routine, and normal operating instructions.
 - b. Test procedures and results of factory tests where required.
 - c. Regulation, control, stopping, and emergency instructions.
 - d. Description of operation sequence by Control CONTRACTOR.
 - e. Shutdown instructions for both short and extended durations.
 - f. Summer and winter operating instructions, as applicable.

- g. Safety precautions.
- h. Special operating instructions.
- i. Installation instructions.
- 3. Maintenance and Overhaul Procedures.
 - a. Routine operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, removal, repair, reinstallation, and reassembly.
- 4. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
- 5. Original CONTRACTOR'S parts list, illustrations, detailed assembly, drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
- 6. Spare parts ordering instructions.
- 7. Where applicable, identify installed spares and other provisions for future Work (e.g., reserved panel space, unused components, wiring, terminals).
- 8. CONTRACTOR'S printed operating and maintenance instructions.
- 9. As-installed, color-coded piping diagrams.
- 10. Charts of valve tag numbers, with the location and friction of each valve.
- B. Maintenance Summary.
 - 1. Compile an individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or subunits.
 - 2. Format.
 - a. Use Maintenance Summary Form and O & M outline bound with this section, or an electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size paper.
 - d. Complete using typewriter or electronic printing.
 - 3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
 - 4. Recommended Spare Parts.
 - a. Data to be consistent with CONTRACTOR'S Bill of Materials/Parts List furnished in O&M manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.
- C. Content for Each Electric or Electronic Item or System.
 - 1. Description of Unit and Component Parts.
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including all control and lighting systems.
 - 2. Circuit Directories of Panelboards.

- a. Electrical service.
- b. Controls.
- c. Communications.
- 3. List of electrical relay settings, and control and alarm contact settings.
- 4. Electrical interconnection wiring diagram, including control and lighting systems.
- 5. As-installed control diagrams by Control CONTRACTOR.
- 6. Operating Procedures.
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Safety precautions.
 - d. Special operating instructions.
- 7. Maintenance Procedures.
 - a. Routine operations.
 - b. Guide to troubleshooting.
 - c. Adjustment and checking.
 - d. List of relay settings, control and alarm contact settings.
- 8. CONTRACTOR'S printed operating and maintenance instructions.
- 9. List of original CONTRACTOR'S spare parts, CONTRACTOR'S current prices, and recommended quantities to be maintained in storage.

1.08 CONTENTS FOR MATERIALS AND FINISHES MANUALS

- A. Content for Architectural Products, Applied Materials, and Finishes.
 - 1. CONTRACTOR'S data, giving full information on products
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for reordering special-manufactured products.
 - 2. Instructions for Care and Maintenance.
 - a. CONTRACTOR'S recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods that are detrimental to product.
 - c. Recommended schedule for cleaning and maintenance.
- B. Content for Moisture Protection and Weather Exposed Products.
 - 1. CONTRACTOR'S data, giving full information on product:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
 - 2. Instructions for inspections, maintenance, and repair.
- 1.09 SUPPLEMENTS
 - A. The form listed below, and following "END OF SECTION", is part of this specification.
 - 1. Form: Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: CONTRACT NO.:

- 1. EQUIPMENT ITEM
- 2. CONTRACTOR
- 3. EQUIPMENT/-FAG NUMBER(S)___
- 4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)
- 5. NAMEPLATE DATA (hp, voltage, speed, etc.)
- 6. CONTRACTOR'S LOCAL REPRESANTATIVE
 - a. Name_____Telephone No. _____ b.Address_____
- c. Email Address______ 7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments Lubricant Frequency (If Applicable) List briefly each maintenance List required frequency Refer by symbol to lubricant operation required and refer to of each maintenance required. specific information in operation. CONTRACTOR's standard maintenance manual, if applicable. (Reference to CONTRACTOR's catalog or sales literature is not acceptable.)

8. LUBRICANT LIST

Reference Symbol	Shell	Standard Oil	Gulf	Arco	Or Equal	
List symbols used in No. 7. above.	List equivalent lubricants, as distributed by each CONTRACTOR for the specific use recommended.					

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost		
Note: Identify parts provided by this Contract with two asterisks.						

DOCUMENT 02000

SITE WORK GENERAL INFORMATION

PART 1 GENERAL

1.01 SUMMARY

- A. The following provisions define materials, methods, conditions, and Work in addition to requirements included in Division 2 sections and shall supplement all sections of Division 2.
- 1.02 DEFINITIONS OF SOILS
 - A. Satisfactory Soil Materials: Satisfactory soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) Designation M145, all soil classification groups.
 - B. Unsatisfactory Soil Materials: Unsatisfactory soil materials are peat and other highly organic soils; and soil materials of any classification that have a moisture content at time of compaction beyond range of 2.5% below and 2.5% above optimum moisture content of soil material, as determined by moisture-density relations test.
 - C. Cohesionless Soil Materials: Cohesionless soil materials include gravels, sand-gravel mixtures, sands and gravelly-sands. Moisture-density relations of cohesionless soils, when plotted on graphs will show straight lines or reverse shaped moisture-density curves.
 - D. Cohesive Soil Materials: Cohesive soil materials include clayey and silty gravels, sandclay mixtures, clayey sands and silty clays, and clays. Moisture-density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture-density curves.
 - E. Rock: Rock includes detached pieces of stone and boulders one-half cubic yard or more in volume, all solid rock in ledges, bedded deposits and conglomerate deposits so firmly cemented as to present the characteristics of solid rock, which may be best loosened for removal by drilling and blasting. Materials that can be removed on a production basis using a D-9 tractor with a No. 9 ripper or equivalent are not included for measurement as rock.
 - F. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be moved by dragline, dredge or other special equipment, are designated as muck. In addition, muck may refer to fluids/muck/tailings from sawing or pumping operations.
 - G. Shale: Argillaceous sedimentary rock derived from clays or silts; typically thinly laminated and weak along planes.

1.03 REFERENCES

- A. The following references are some of the important references used in Division 2, "Site Construction". For a more specific reference, see the specification section in this division.
- B. American Association of State Highway and Transportation Officials (AASHTO)
- C. AASHTO M145Soils Classification
 - AASHTO M167-00 Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe Pipe-Arches and Arches AASHTO T180 Standard Specifications for Moisture-Density Relations of Soils
- D. American National Standards Institute Standards (ANSI)
 - 1. ANSI A21.51 Ductile Iron Pipe Centrifugally Cast-In-Metal Molds or Sand-Lined Molds, for Water or Other Liquids
 - 2. ANSI A21.4-I971 See AWWA C 104-71
 - 3. ANSI A21.10-I971 See AWWA C 110-71
 - 4. ANSI A21.11-1972See AWWA C 111-72
 - 5. ANSI A21.50-1971 See AWWA H 3-71
- E. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 Carbon Structural Steel
 - 2. ASTM A47 Ferritic Malleable Iron Castings
 - 3. ASTM A48 Gray Iron Castings
 - 4. ASTM A53 Specification for Pipe; Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 5. ASTM A74 Cast Iron Soil Pipe and Fittings
 - 6. ASTM A121 Zinc-Coated (Galvanized) Steel Barbed Wire
 - 7. ASTM A123 Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products
 - 8. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates
 - 9. ASTM A392 Zinc-Coated Steel Chain-Link Fence Fabric
 - 10. ASTM A491 Aluminum-Coated Steel Chain-Link Fence Fabric
 - 11. ASTM A663 Steel Bars, Carbon, Merchant Quality, Mechanical Properties
 - 12. ASTM A885 Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert and Underdrain Pipe
 - 13. ASTM B211 Aluminum and Aluminum-Alloy Bar, Rod and Wire
 - 14. ASTM C5 Quicklime for Structural Purposes
 - 15. ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sewer Pipe

- 16. ASTM C150 Portland Cement
- 17. ASTM C478 Precast Reinforced Concrete Manhole Sections
- 18. ASTM C564 Rubber gaskets for Cast Iron Soil Pipe and Fittings
- 19. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbs/ft.3)
- 20. ASTM D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method
- 21. ASTM D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.-lbf/ft³)
- 22. ASTM D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- 23. ASTM D2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- 24. ASTM D2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- 25. ASTM D2422 Standard Classification of Industrial Fluid Lubricants by Viscosity System
- 26. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- 27. ASTM D2922 Density of Soil and Sand-Aggregate in Place by Nuclear Methods (Shallow Depth)
- 28. ASTM D3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- 29. ASTM D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
- 30. ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- F. Comply with the applicable American Water Works Association (AWWA) standards.
 - 1. AWWA C104-71 Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - 2. AWWA C110-71 Ductile-Iron and Gray Iron and Fittings, 3 in. through 48 in. for Water and Other Liquids
 - 3. AWWA C111-72 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 4. AWWA C150-96 Thickness Design of Ductile-Iron Pipe
 - 5. AWWA C301 Prestressed concrete pressure pipe, steel-cylinder type, for water and other liquids.
 - 6. AWWA C304 Design of Prestressed Concrete Cylinder Pipe.
 - 7. AWWA C500 Metal-Seated Gate Valves for Water Supply Service

- 8. AWWA C502 Standard for Dry Barrel Fire Hydrants
- 9. AWWA C504 Standard for Rubberseated Butterfly Valves
- 10. AWWA C600 Installation of Cast Iron Water Mains
- 11. AWWA C651 Disinfecting Water Mains
- 12. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. thru 12 in.
- G. Comply with the following applicable Federal specifications:
 - 1. WW-P406b Pipe, Steel (Seamless and Welded) (For Ordinary Use)
 - 2. WW-P521e Unions, Pipe Steel or Malleable Irons; Threaded Connection
 - 3. WW-V54c Valve Gate Bronze (125,150, and 200 pound) Screwed, Flanged, Solder-End, (For Land Use)
- H. Comply with Texas Department of Transportation (TxDOT), formerly Texas Department of Highways and Public Transportation (TDHPT):
 - 1. Manual of Testing Procedures
 - 2. Standard Specifications for Construction of Highways, Streets and Bridges, I993 (English), 1995 (Metric). In case of conflict between these two documents, the most stringent requirement will apply.
 - 3. Construction Bulletin C-11
 - 4. Construction Bulletin C-14
- I. Safety, Codes and Standards: Perform the Work under Division 2 sections in compliance with applicable requirements of local codes and governing authorities having jurisdiction.
- J. Soil Compaction Control: Qualified geotechnical technicians will be employed by the OWNER for the purpose of identifying soils, checking densities and classifying soil materials during construction. Charges for this service are to be paid for by the OWNER. The Contractor is responsible for Quality Control as per Division 1, "General Requirements".
- K. All site construction shall be in strict compliance with the "Erosion Control Plan" for the Project as well as the project's specific "Erosion Control Plan" as prepared by the Contractor.

1.04 PERFORMANCE CONDITIONS

A. Soils Conditions: Site Topography and topographic maps, soil reports and other topographic or soil data shown on the Drawings or included in the Specifications are for information of the Contractor, and neither the Engineer nor the OWNER is responsible for their accuracy, completeness or usefulness and meaning. The Contractor shall make such additional investigations as required to acquaint himself adequately with site topography, and subsurface soil condition for preparation of his/her bid, and for successful execution of Work.

- B. Existing Conditions: The Contractor shall investigate the site to determine necessary data to bid project and to perform the Work required under the Contract or in the specification sections of Division 2. Such investigation may include but not be limited to site visits, soil borings, chemical and physical tests and research of public and private records.
- C. Protection of Monuments, Landscape Features, Work and Structures:
 - 1. Monuments: The Contractor shall prevent destruction of all survey monuments, benchmarks, property corners and all other survey points. Where removal of such points is necessary for accomplishment of Work, the Contractor shall inform the Engineer in writing, prior to disturbance of any point. Do not disturb point until written permission to do so has been issued by the Engineer. Points whose removal is allowed shall be permanently referenced prior to their disturbance. Furnish clean notes and sketches of all reference points to the Engineer, all affected property owners, government bodies or utility companies.
 - 2. Landscape: Protect trees, shrubs, grass or other growth designated to remain in place, or outside of limits of Work, during accomplishment of the Work. Do not damage in any manner. There will be no parking or storage of vehicles, equipment, or materials in around or under any tree. Such growth damaged by the Contractor shall be repaired as directed at no cost to the OWNER. Lawn surfaces, embankments, cut slopes, ditches, or other surfaces disturbed by Contractor shall be regraded to original shape, and grass or lawn surface replaced in kind, at no additional cost to the OWNER.
 - 3. Structures: Protect structures outside of limits of the Work or designated to remain in place during progress of the Work. Any structure damaged in any manner shall be repaired or restored to its original condition, as directed by the Engineer at no cost to the OWNER. Replace sidewalks, curbs, concrete or asphalt pavement in kind, in accordance with applicable sections of the Specifications or as directed by the Engineer.
 - 4. Protection of Work: The Contractor shall be solely responsible for the work of other contractors in area and protection of his/her work. Such grading as is necessary to prevent damage to work by water shall be solely the responsibility of the Contractor and shall be at no additional cost to the OWNER. The Engineer may direct the Contractor to perform necessary grading and drainage to prevent surface runoff from damaging the Work area.
- D. Work Within Easements:
 - 1. All Work on private or public property not owned by the OWNER shall be within limits of permanent or construction easements obtained by the OWNER. The Contractor shall coordinate with the OWNER as required to determine which easements have been acquired and shall ensure that all Work, materials and equipment do not encroach beyond limits of easements.
 - 2. Contractor shall remove from easements all construction debris, including, but not limited to, felled trees and brush, rock, trash and other objectionable material.

1.05 CLASSIFICATIONS OF EXCAVATIONS

A. The following classifications of excavation will be made only when the Engineer authorizes additional earth excavation and when rock excavation is encountered in Work.

Do not perform such Work until material to be excavated has been cross-sectioned and classified by the Engineer.

- 1. Earth excavation consists of removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on subsurface conditions, and all other materials encountered that are not classified as rock excavation or unauthorized excavation.
- 2. Rock excavation consists of removal and disposal of materials encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of a ripper or other special equipment, except such materials that are classified as earth excavation. Typical of materials classified as rock are boulders 1/2 cubic yard or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.
- B. Unauthorized Excavation: Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations without specific direction of the Engineer. Replace unauthorized excavation as specified in Division 2 sections.
- C. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Engineer.
- Excavated Material: The Contractor is cautioned to follow directions specified in Division 2 sections regarding procedures for disposal of the asphalt and concrete pavement materials, excess soils, shale and contaminated materials.
- PART 2 PRODUCTS
- 2.01 EQUIPMENT
 - A. Choice of equipment to perform the Work shall be the responsibility of the Contractor. However, any equipment that results in damage to material, or inaccurate work or is otherwise objectionable shall be promptly replaced as directed by the Engineer.
- 2.02 FIELD DRAWINGS
 - A. If changes to Contract Drawings are required due to field conditions and are approved by the Engineer, the Contractor shall record changes in accordance with Section 01720, "Project Record Documents." Field drawings shall show changes to size, location, and elevations.
- 2.03 SPECIAL SAFETY REQUIREMENTS
 - A. Comply with all Federal, State and Local Safety Codes and Regulations, including all applicable Occupational Safety and Health Administration (OSHA) standards, at all

times. Contractor shall be responsible for educating his/her supervisors and employees of safety requirements and practices to be followed during course of the Work.

- 1. Barricades: Barricade any open excavation and install adequate warning lights. Provide temporary bridges to maintain traffic and accessibility of facilities in area of Work during excavation operations. Provide a flagman, as required to maintain traffic controls and safety.
- 2. Access: Provide safe access to bottom of trenches or excavations, including, as appropriate, ladders, ramps, steps or other access, where depth of trench or excavation is greater than three feet, and where access to trench or excavation is required for the Work.
- 3. Side Slopes: Sides of excavations and trench walls shall be sloped, benched, sheeted and shored to maintain stability of wall or sides. Pile materials obtained from the excavation a minimum of four feet from edge of excavation. Keep roads, streets, sidewalks, railroad tracks and traveled ways clear of excavation material at all times. The Contractor shall be responsible to ensure stability of trench and excavation walls for the safety of personnel and the Work. Trenches and excavation walls shall be constructed in compliance with the latest OSHA and State of Texas standards.
- 4. Blasting: Blasting will not be allowed.
- 5. Working Conditions: Nothing contained herein shall be construed to relieve the Contractor of his/her responsibility to provide and maintain safe and clean working conditions for his/her employees and others in the construction area.

2.04 DEWATERING

- A. Perform excavation work in a manner to prevent surface water and subsurface or ground water from flowing into excavations, and to prevent water from flooding project site and surrounding areas.
- B. Do not allow water to accumulate in excavations. Remove water from excavations using dewatering methods that will prevent softening or erosion of foundation bottoms, undercutting footings, and soil changes detrimental to the stability of subgrades and foundations. Provide and maintain pumps, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations and keep the site continually and effectively drained.
- C. Convey water removed from excavations and rainwater to collecting or runoff areas. Provide and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations for site utilities as temporary ditches.
- D. Storm water control measures outlined in the "Storm Water Pollution Prevention Plan" as prepared by the Contractor shall be followed throughout the Project.
- E. Any water/muck/slurry tailings from saw cutting, drilling or pavement marking removal operations shall be collected by a vacuum truck and its contents be disposed of as directed by the Owner's Authorized Representative.

2.05 CLEAN-UP

A. Keep the Work area free of debris, trash, garbage and other offensive waste material and keep all construction materials such as, but not limited to, sheeting, shoring, formwork, pipes and reinforcing steel, stockpiled in a neat, orderly manner, until ready for use on job site. During construction keep construction zone, parking areas, ramps, walkways, passages, traveled ways, adjacent to area of the Work clean and open to vehicular and pedestrian traffic. Upon completion of any stage of the Work in any area, remove all debris, trash, litter, and construction material, and leave the area in suitable condition for the next stage of construction or for use of the OWNER. Conduct daily clean-up of the Work area.

END OF SECTION

SECTION 02050

DEMOLITION, CUTTING AND PATCHING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes the removal of existing construction to the limits as indicated and specified. CONTRACTOR shall comply with the requirements of Section 01321 Progress Schedule, in scheduling and completing all demolition Work.
- B. Demolition includes the complete or partial removal and turn over to OWNER, salvage or disposal of equipment and materials as indicated or specified.
- C. Relocation of existing construction includes isolation, draining, cutting, joining, new piping, new fittings, new junction boxes, new conduit, new wiring, etc. as required to reinstall a fully functional system as indicated, as specified, or as required to accommodate the new Work.
- D. This section covers demolition, as well as initial modifications necessary to allow the existing plant to operate during all construction phases and final modifications during activation of the new facility. This section also includes complete or partial removal and disposal of existing structures, foundations, slabs, piping, mechanical, electrical, existing (to be abandoned or removed) buried piping and miscellaneous appurtenances encountered during construction. This section does not purport to cover all of the activities necessary and requires the CONTRACTOR to exercise due concern for plant operations and diligently direct all construction activities toward maintaining continuous operation of the existing plant during all construction phases.
- E. CONTRACTOR shall be responsible for all demolition cutting, core drilling, fitting and patching, including attendant excavation and backfill, required to complete the Work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to provide for installation of ill-timed Work.
 - 3. Remove and replace defective Work.
 - 4. Remove and replace Work not conforming to requirements of contract documents.
 - 5. Remove samples of installed Work as specified for testing.
 - 6. Provide penetrations of structural and nonstructural surfaces for installation of piping and electrical conduit.
- F. Demolition includes:
 - 1. Complete demolition of existing yard structures which are encountered in the way of new Work.
 - 2. Partial demolition as necessary below finished grade of all existing yard structures which are not in-service or required for construction.

- 3. Temporary modification of structures, piping, equipment, appurtenances and utilities as necessary to allow for operation of the plant during all construction phases.
- 4. Demolition of existing structures, walls, foundations and slabs to the limits shown on the drawings.
- 5. Demolition of equipment, piping, appurtenances and associated electrical to the limits shown on the drawings.
- 6. Removal and/or plugging of existing yard piping.
- 7. Removal and replacement of existing chain link fence.
- 8. Demolition partial removal and cutting of existing masonry or concrete as required for new construction.
- 9. Temporary modifications of existing piping, fittings, and instrumentation required to maintain plant operations during construction
- G. Related Requirements in Other Parts of the Project Manual. Basic responsibilities of parties: Conditions of the contract.
- H. Related Requirements Specified in Other Sections:
 - 1. Division 1 General Provisions.
 - 2. Divisions 2 through 17, as applicable.

1.02 SUBMITTALS

- A. Lead and Asbestos Abatement Plan
- B. Schedule: Submit proposed methods and operations of demolition, cutting and patching in accordance with Section 01300 Submittals, and Section 01321 Progress Schedule.
- C. The schedule shall include:
 - 1. Identification of the Project.
 - 2. Description of the affected Work.
 - 3. The necessity for cutting, alteration or excavation, when applicable.
 - 4. The effect on the Work of the OWNER or any separate CONTRACTOR, or on the structural or weatherproof integrity of the Project.
 - 5. Coordination schedule for shut-off, capping and continuation of utility services as required.
 - 6. Description of the proposed Work shall include:
 - a. The scope and detailed sequence of cutting, patching, alteration, or excavation.
 - b. The trades who will execute the Work.
 - c. Products proposed to be used.
 - d. The extent of refinishing to be done.
 - e. Sequence and methods of removal and disposal of demolished materials.

- f. Alternatives to cutting and patching, when applicable.
- g. Written permission of any separate CONTRACTOR whose Work will be affected.
- D. Submit a written notice to OWNER designating the date and the time the Work will begin.

1.03 PROTECTION

- A. Protect all reference points, benchmarks and monuments from dislocation or damage. Replace or repair immediately any points damaged, destroyed or dislocated. Protect and maintain all conduits, drains, inlets, sewers, pipes and wires that are to remain on the property.
- B. Provide adequate protective measures to protect workmen and passersby from falling material and dust. Sprinkle and dampen all mortar and other dusty substances from the beginning of work to its completion.
- C. Provide, erect and maintain all lights, barricades, warning signs and guards as necessary for the protection of streets, sidewalks and all adjoining property.
- D. Salvaged materials and rubbish shall be lowered or transported by means of reasonable dust proof chutes or suitable conveyances, and all mortar and other dusty substances shall be sprinkled and dampened from the beginning of such work to its completion.
- E. Take measures for safety of personnel as recommended in the AGC Manual of Accident Prevention I Construction and as required by OSHA.

1.04 JOB CONDITIONS

- A. Condition of Structures: OWNER assumes no responsibility for actual condition of equipment and portions of structures to be demolished. Conditions existing at time of inspection for bidding purposes will be maintained by OWNER insofar as practicable.
- B. Explosives: Use of explosives will not be permitted.
- C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from OWNER. Provide alternate routes around closed or obstructed traffic ways if required by OWNER.
- D. Support System. The support system/shoring plan shall be designed by a licensed Professional Engineer in the state of Texas. ENGINEER shall seal the plan and a copy of the plan shall remain on site at all-times. CONTRACTOR shall be responsible for retaining the services of a licensed Professional Engineer.
- E. Damages: CONTRACTOR shall be responsible for any damage to streets, curbs, or other property not specifically called for as an item to be demolished. Promptly repair damages caused to adjacent facilities by demolition operations at no cost to OWNER.
- F. Utility Services: Maintain existing utilities required to remain, keep in service, and protect against damage during demolition operations.

- 1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the OWNER. Provide temporary services during interruptions to existing utilities, as acceptable to OWNER.
- 2. When utility lines are encountered which are not indicated in the plans, the OWNER shall be notified.
- G. Operating Facilities
 - 1. Perform Work in a manner which will not disrupt the operation of existing in service facilities, except as allowed in Section 01321 Progress Schedule.
 - 2. Provide temporary services to assure uninterrupted operation of existing facilities, except where service disruption is allowed for as specifically specified in Section 01321 Progress Schedule, or specifically noted on the drawings.
 - 3. Stage materials, equipment and Work in a manner which will not obstruct OWNER access to operate and maintain existing operating facility components.
 - 4. Sequence and perform Work to minimize disruption of existing facilities.

PART 2 PRODUCTS

A. Comply with specifications and standards for each specific product involved.

PART 3 EXECUTION

- 3.01 SAFETY REQUIREMENTS
 - A. All work shall be performed in conformance with the rules and regulations pertaining to safety established by, but not limited to, OSHA, City of Brownsville, and as specified elsewhere in these Specifications.
- 3.02 INSPECTION
 - A. Inspect existing conditions of the Project, including elements subject to damage or to movement during demolition, cutting, patching, splicing or relocation.
 - B. After uncovering Work, inspect the conditions affecting the installation of products or performance of the Work.
 - C. Report unsatisfactory or questionable conditions to the OWNER in writing; do not proceed with the Work until the OWNER has provided further instructions.
 - D. Conditions which are visible without uncovering Work shall be reported to the OWNER in writing no later than two (2) weeks after site mobilization.
 - E. Test equipment for proper function after relocation.
 - F. The CONTRACTOR shall be liable for any lost or damage items which are to be reused. Any lost or damage items shall be replaced with products identical to the existing items or equivalent, as determined by the OWNER. The OWNER, along with the ENGINEER, shall have sole discretion in determining what product is equivalent.

3.03 PREPARATION

- A. Provide devices and methods to protect other portions of the Project from damage.
- B. Provide protection from the elements for that portion of the Project which may be exposed by demolition, cutting and patching Work, and maintain excavations free from water.

3.04 PERFORMANCE

- A. Removal and Storage of Equipment for Reuse. No equipment shall be removed without the approval and consent of the OWNER. The CONTRACTOR shall agree to maintain all equipment in the same condition as when it was removed. The condition of the equipment shall be determined prior to removal by the ENGINEER. The CONTRACTOR shall use due care in the removal and transport of equipment to be salvaged. The CONTRACTOR assumes the responsibility of assuring that the equipment is properly stored and maintained.
- B. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.
 - 1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
 - 2. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations, as directed by the OWNER or governing authorities. Return adjacent areas to condition existing prior to start of Work.
 - 3. Prior to demolition inside existing structures, provide covers consisting of plastic sheeting and framing over existing pumps, motors, switchgear and control panels. Maintain covers during demolition operations.
- C. Structure Demolition: Demolish as required and remove from site. Use such methods as required to complete Work within limitations of governing regulations.
 - 1. Proceed with demolition in a systematic manner, from top to ground.
 - 2. Locate demolition equipment throughout structure and remove materials so as to not impose excessive loads to supporting walls, floors or framing.
 - Execute cutting and demolition by methods which will prevent damage to other Work, and will provide proper surfaces to receive installation of repairs. Torch cutting will not be permitted.
 - 4. Where physical cutting is required, cut Work with sawing and grinding tools, not with hammering and chopping tools. Unless otherwise specified, core drill or saw cut openings through all concrete Work. Core drilling shall be done utilizing diamond bits. Corners shall not be over cut without prior written approval from the ENGINEER.
 - 5. Torch cutting of steel members is not allowed.
- D. Execute excavating and backfilling by methods which will prevent settlement or damage to other Work.

- E. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- F. Fit Work watertight and airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- G. Patch with seams which are durable and as invisible as possible. Restore exposed finishes of patched areas and, where necessary, extend finish restoration onto retained Work, adjoining, in a manner which will eliminate evidence of patching.
- H. Take care in the removal of equipment and materials to be salvaged to prevent damage to such. Equipment to be retained by the OWNER shall be sufficiently dismantled to permit thorough cleaning and draining. All valves shall be left in the open position once cleaned. All discontinued piping shall be capped and openings remaining after removal of existing equipment, fittings, valves and/or appurtenances shall be plugged and sealed.
- I. Remove all buried piping encountered during excavation unless otherwise shown on the drawings or directed by the OWNER. Pipes indicated to be abandoned but not removed shall have open ends plugged with concrete. The ENGINEER will determine the location of where pipes shall be plugged. The OWNER shall be notified of any existing line, wire, pipelines, water lines, sewer lines, or other facility encountered in the demolition which was not shown on the plans.
- J. The CONTRACTOR shall backfill all demolition areas approximately to existing ground level or foundation level of new construction, as applicable, as shown on the Drawings. Backfill material shall meet the requirements for secondary backfill, as applicable, and backfill compaction shall be in accordance with the applicable requirements of Section 02217, Excavating, Backfilling, and Compaction for Utilities. Building debris shall not be used as backfill material. In all areas not backfilled to ground level, the CONTRACTOR shall erect safety barriers around the excavation.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. The OWNER shall retain salvage rights to all material and equipment as specified in Paragraph 3.06 of this Section. All materials and equipment retained by the OWNER shall be transported and delivered to an on-site location designated by the OWNER.
- B. Any material or equipment not retained by the OWNER shall become the property of the CONTRACTOR and shall be removed from the site and disposed of by the CONTRACTOR in accordance with applicable regulations and laws.
- C. Any material or equipment not retained by the OWNER shall be immediately removed from the site and disposed of by the CONTRACTOR in accordance with the applicable regulations and laws.
- D. Do not sell or store materials on site.
- E. Maintain a neat, clean appearance on the site at all times and avoid great accumulation of debris.

3.06 REMOVAL AND STORAGE OF EQUIPMENT FOR REUSE

A. No equipment shall be removed without the approval and consent of the OWNER. The CONTRACTOR shall agree to maintain all equipment in the same condition as when it was removed. The condition of the equipment shall be determined prior to removal by The ENGINEER. The CONTRACTOR assumes the responsibility of assuring that the equipment is properly stored and maintained.

END OF SECTION

SECTION 02200

SITE PREPARATION

PART 1 GENERAL

1.01 DEFINITIONS

- A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- B. Clearing: Removal of interfering or objectionable materials lying on or protruding above ground surface.
- C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6-inch below subgrade.
- D. Scalping: Removal of sod without removing more than upper 3-inch of topsoil.
- E. Stripping: Removal of topsoil remaining after applicable scalping is completed.
- F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SUBMITTALS

- A. Shop Drawings: Drawings clearly showing clearing, grubbing, and stripping limits.
- 1.03 QUALITY ASSURANCE
 - A. Obtain OWNER's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.
- 1.04 SCHEDULING AND SEQUENCING
 - A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Clear, grub, and strip areas actually needed for staging area or site improvements within limits shown or specified.
 - B. Do not injure or deface vegetation that is not designated for removal.
- 3.02 LIMITS
 - A. As follows, but not to extend beyond Project limits.Excavation Including Trenches:

- 1. Along alignment and improvements as necessary for accessibility and construction activities.
- 2. Fill:
 - a. Clearing and Grubbing: Along alignment as necessary for accessibility and construction activities.
 - b. Stripping and Scalping: Along alignment as necessary for accessibility and construction activities.
- 3. Staging Area:
 - a. Clearing: 5-feet beyond perimeter.
 - b. Scalping and Stripping: Not required.
 - c. Grubbing: 5-feet beyond perimeter.
- 4. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within Project limits.
- 3.03 CLEARING
 - A. Clear areas within limits of construction.
 - B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
 - C. Cut stumps not designated for grubbing flush with ground surface grind down to 6-

inches below surface, remove debris, and if disturbed, restore surrounding area to its

original condition.

- D. Cut off shrubs, brush, weeds, and grasses to within 2-inch of ground surface.
- 3.04 GRUBBING
 - A. Grub areas within limits of construction.

3.05 SCALPING

- A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.
- B. Scalp areas within limits shown or specified.
- 3.06 STRIPPING
 - A. Do not remove topsoil until after scalping is completed.
 - B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.
 - C. Stockpile strippings, meeting requirements of Section 02910 Soil Preparation, for

topsoil, separately from other excavated material.

3.07 TREE REMOVAL OUTSIDE CLEARING LIMITS

- A. Remove trees within Project limits:
 - 1. Dead, dying, leaning or otherwise unsound trees that may strike and damage project facilities in falling.
 - 2. Trees designated by OWNER.
- B. Cut stumps off flush with ground, grind down to 6-inches below surface, remove debris, and if disturbed, restore surrounding area to its original condition.

3.08 SALVAGE

- A. Logs and timber called out for demolition may be sold for CONTRACTOR'S benefit. Promptly remove logs and timber that are not sold by CONTRACTOR from Project site.
- B. Sod called out for demolition with commercial value may be sold for CONTRACTOR's benefit. Promptly remove sod that is not sold by CONTRACTOR from Project site.
- 3.09 DISPOSAL
 - A. Clearing and Grubbing Debris:
 - 1. Dispose of debris offsite.
 - 2. Burning of debris onsite will not be allowed.
 - 3. Woody debris shall be chipped. Chips shall be used for landscaping, if approved by OWNER, onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Mixture layer shall be limited to the top 12-inches of topsoil so as not to have a negative effect on the compaction requirements. Maximum dimension of chipped material used onsite shall be 1/4 –inch by 2-inch. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.
 - 4. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.
 - B. Scalpings: As specified for clearing and grubbing debris.
 - C. Strippings:
 - 1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
 - 2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

DOCUMENT 02212

FINISH GRADING

PART 1 GENERAL

- 1.01 QUALITY ASSURANCE
 - A. Topsoil Material and Source: Inspected and approved by Project Manager prior to transporting.
- 1.02 DEFINITIONS
 - A. Maximum Dry Density Determined by ASTM D698.
 - B. Optimum Moisture Determined by ASTM D698.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Topsoil: Stockpiled on-site material, supplemented by approved off-site material as required.
 - 1. Stockpiled and Off-site Topsoil: Natural friable dark brown sandy clay soil typical of the region, free from lumps, excessive clay, toxic substances, roots, debris, vegetation, caliche subsoils, stones over 1-inch in a maximum dimension, and containing no salt or alkali.
- PART 3 EXECUTION
- 3.01 PERFORMANCE
 - A. Finish Grading:
 - 1. Rough grade compacted fill allowing for a maximum amount of natural settlement and compact. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc., in excess of three inches in size. Remove fill material which has been contaminated with petroleum products.
 - 2. Compact areas which are to receive paving or stabilizing base to sub-grade elevation, and to at least 95 percent maximum dry density. Moisture will be within -2 to +3 percent of optimum moisture.
 - 3. Bring compacted fills to required levels, profiles and contours. Make changes in the grade gradually. Blend slopes into level areas.
 - 4. Slope grades away from structures minimum 6 inches in 6 feet unless otherwise indicated on Drawings.
 - 5. Where fill to required subgrade elevation is less than 6 inches, scarify to a depth of 6 inches and compact.

- 6. Cultivate subgrade to a depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subgrades.
- B. Placing Topsoil:
 - 1. Place in minimum six inches depth up to finished grade elevations in grassed areas. Leave plant bed areas six inches low to receive bed mix material a specified in Section 02922.
 - 2. Use topsoil in relatively dry state. Place during dry weather.
 - 3. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of subgrades. Rake until surfaces are smooth.
 - 4. Remove stone, roots, grass, weeds, debris and other foreign material while spreading.
 - 5. Manually spread topsoil around trees, plants, and building to prevent damage which may be caused by grading equipment.
 - 6. Lightly compact, 90% minimum of maximum dry density as defined by ASTM D698, (Standard Proctor) zero to 4% above optimum moisture, topsoil after placing.

3.02 MAINTENANCE

- A. Protect newly graded areas from traffic and erosion; keep free of trash and rubbish.
- B. Repair settled, eroded or rutted areas, using additional topsoil upon final acceptance of the facilities.

END OF SECTION

SECTION 02215

EXCAVATION

PART 1 GENERAL

- 1.01 QUALITY ASSURANCE
 - A. Provide adequate survey control to avoid unauthorized over excavation.
- 1.02 WEATHER LIMITATIONS
 - A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.
 - B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.
- 1.03 SEQUENCING AND SCHEDULING
 - A. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 02200 Site Preparation prior to excavating.
 - B. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavation and from flooding project site and surrounding area. Any water accumulating in excavations or onsite shall be removed by pumping or by other methods accepted by the OWNER.
 - C. Excavation Support: Install and maintain as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1-foot except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.
 - B. Do not over excavate without written authorization of OWNER.
 - C. Remove or protect obstructions as shown and as specified in Section 01500 Construction Facilities and Temporary Control, Paragraph 1.06.
- 3.02 UNCLASSIFIED EXCAVATION
 - A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.03 SAFETY

A. All excavation required on this project shall be accomplished as required by the Provisions of Part 1926, Subpart P-Excavations, Trenching and Shoring of the Occupational Safety and Health Administration's Standard and Interpretations: and all applicable State and Local Rules and Regulations.

3.04 TRENCH WIDTH

- A. Minimum Width of Trenches:
 - 1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
 - a. Less Than 4-inch Outside Diameter or Width: 12 inches.
 - b. Greater than 4-inch Outside Diameter or Width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.
 - 2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.
 - 3. Increase trench widths by thicknesses of sheeting.

3.05 EMBANKMENT AND CUT SLOPES

- A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
- B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.
- C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.

3.06 STOCKPILING EXCAVATED MATERIAL

- A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.
- B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.
- C. Confine stockpiles to within easements, rights-of-way, and approved/accepted work areas. Do not obstruct roads or streets.
- D. Do not stockpile excavated material adjacent to trenches and other excavations unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.
- E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

- 3.07 DISPOSAL OF SPOIL
 - A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.
 - B. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 02200 Site Preparation for clearing and grubbing debris.

END OF SECTION

SECTION 02217

EXCAVATING, BACKFILLING, AND COMPACTION FOR UTILITIES

- PART 1 GENERAL
- 1.01 DESCRIPTION
 - A. The work of this Section includes excavating, backfilling, and compaction as indicated on the drawings and specified herein. The work shall include all necessary pumping or bailing, sheeting, and drainage.
- 1.02 SUBMITTALS
 - A. As specified in Section 01300 Submittals.
 - B. The CONTRACTOR shall submit for record purposes only, and not for review, shop drawings showing the location and layout of proposed sheeting, shoring, and bracing.
- 1.03 GENERAL REQUIREMENTS
 - A. The work performed under this specification shall be constructed to the lines, grades, elevations, slopes, and cross sections indicated on the drawings and specified herein.
 - B. Utility lines and structures, which are to remain in service, shall be protected from damage as a result of the CONTRACTOR's operations. Where utility lines or structures not shown on the drawings are encountered, the CONTRACTOR shall report them to the OWNER before proceeding with the work. The CONTRACTOR shall bear the cost of repair or replacement of utility lines or structures, which are shown on the drawings or otherwise made known to the CONTRACTOR, which are broken or damaged by his operations.
- 1.04 RELATED WORK
 - A. Section 02223 Trench and Excavation Safety Systems
 - B. Section 02227 Waste Material Disposal
 - C. Section 02530 Dewatering and Drainage
- 1.05 SAFETY
 - A. The CONTRACTOR shall at all times conform to all applicable regulations of Subpart "P" entitled, "Excavation" of OSHA Construction Regulations and all applicable state and local rules and regulations. CONTRACTOR shall provide names, proof of competent person and training of person on site during excavation. Also CONTRACTOR shall provide name and number of safety officer.

1.06 CODES, ORDINANCES, AND STATUTES

A. CONTRACTOR shall familiarize himself with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.

1.07 SHORING, SHEETING, BRACING, AND SLOPING

- A. In areas which the sides of the trench is unstable or the depth of the trench is excessive, the CONTRACTOR shall install and maintain shoring, sheeting, bracing, and sloping necessary to keep and to prevent any movement which may damage adjacent pavements, utilities, or structures, damage or delay the work, or endanger life and health. All shoring, sheeting, bracing, and sloping shall be installed and maintained as required by OSHA and other applicable governmental agencies.
- 1.08 QUALITY CONTROL AND ASSURANCE
 - A. The CONTRACTOR shall procure, store, and place materials from either on-site or offsite sources which comply with the specified requirements.
 - B. The OWNER will have such tests and inspections as he may desire performed by an independent testing laboratory for his guidance and quality assurance of the work. Payment for such tests will be the responsibility of the CONTRACTOR. Quality control tests shall be performed by an independent laboratory procured by the CONTRACTOR. Final selection of the CONTRACTOR's laboratory is subject to approval by the OWNER. Testing and laboratory services are specified in Section 01400 Quality Control.
 - C. All subgrades except in pipe trenches shall be inspected and tested at one compaction test per thousand square feet of surface area. In the event that a lift fails a compaction test, all costs for retesting for compliance shall be the CONTRACTOR's responsibility. All materials proposed for incorporation into the work shall be analyzed prior to their use for compliance to these Contract Documents.
- 1.09 SPOIL
 - A. On site material deemed unsuitable by the OWNER, either from tests or visual inspection, for use as fill or backfill shall be removed from the site. Construction debris and other debris contained within this material shall be removed and disposed of as described in paragraph 1.10 below.

1.10 CLEAN-UP

A. The CONTRACTOR shall remove rubbish, debris, temporary materials, and waste excavated materials from the site. Such materials shall be disposed of in accordance with applicable laws, regulations, and permits. The CONTRACTOR shall have approval from the OWNER of the property upon which the material will be disposed. The CONTRACTOR shall restore staging and storage areas and temporary roads to original condition or as shown on the plans to the satisfaction of the OWNER as a condition for final acceptance and payment.

1.11 SILT BARRIERS

- A. The CONTRACTOR shall provide silt fences or rock filter dams to prevent siltation of waterways and drainage courses.
- 1.12 EXCESS EXCAVATED MATERIALS
 - A. All excess excavated materials shall become the property of the CONTRACTOR and shall be disposed of by the CONTRACTOR off the Project site.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Gravel Subgrade Filler. Gravel subgrade filler is defined as backfill located below the bedding of the pipe. It is to be used in areas where the bottom of the trench is determined to be unstable. It shall consist of ³/₄ inch gravel and shall be placed in depths determined by the field observer.
 - B. Bedding. Pipe bedding is defined as backfill that begins at minimum 6 inches or 1/8 inch of the outside diameter of the pipe, whichever is greater, below the bottom of the pipe and extends to the intersection of a right angle beginning at the center of the pipe and its intersection with the outside face of the pipe bottom as shown in the Drawings. Further information and requirements may be found in BPUB Standard Specifications for Construction, Item No. 804. Pipe bedding shall be composed of well-graded, crushed stone or gravel conforming to the requirements, as found in BPUB Standard Specifications for Construction, Item No. 804.
 - C. Initial Backfill. Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the pipe bedding to a point one foot (1') above the top of the pipe. Initial backfill shall conform to the requirements found in PBUB Standard Specifications for Construction, Item No. 804.
 - D. Secondary Backfill. Secondary backfill is defined as backfill from one foot (1') above the top of the pipe to the top of the trench. Top of the trench is natural ground unless topsoil has been stripped to be replaced or a pavement section is to be placed over the trench. Secondary backfill is defined in paragraph 3.07 of this Section and shall be free of brush and debris. Further information and requirements may be found in BPUB Standard Specifications for Construction, Item No. 804. The more stringent of the two requirements shall govern should the requirements differ.
 - E. Select Material.
 - 1. Refer to Section 02220 Structural Excavation, Fill and Backfill, paragraph 2.01.
 - F. Water. Water used in compaction shall be clean and free from oil and grease. It shall not contain any organic matter or any other deleterious substances.
 - G. Controlled Low Strength Material (Flowable Fill). Flowable fill is a low strength concrete material suitable as a backfill for utility trenches, abandoned pipes, manholes and valves. It is a heavy material and will exert a high fluid pressure against any forms, embankment or wall used to contain the flowable fill.

1. Materials shall conform to:

Cement - ASTM C150

Fly Ash - ASTM C618, Class C or Class F

- Water ASTM C94
- Fine Aggregates Natural or manufactured sand or a combination thereof, free from injurious amount of salt, alkali, vegetable matter or other objectionable material. It is intended that the fine aggregate be fine enough to stay in suspension in the mortar to the extent required for proper flow. The fine aggregate shall conform to the following gradation:

<u>SIEVE SIZE</u>	<u>% PASSING</u>		
3/4 inch	100		
No. 200	0 - 30		

- 2. If a flowable mixture cannot be produced, the sand may be rejected. Admixtures ASTM C260 and/or C494
- 3. Mix Design. The 28 calendar day design unconfined compressive strength shall be between 80 and 150 PSI, while 3 calendar day strength shall exceed 25 PSI.
- H. Compaction Equipment.
 - 1. Compaction equipment shall be of suitable type and adequate to obtain the densities specified, and shall provide satisfactory breakdown of materials to form a dense fill.
 - 2. Compaction equipment shall be operated in strict accordance with the MANUFACTURER's instructions and recommendations. Equipment shall be maintained in such condition that it will deliver the MANUFACTURER's rated compactive effort. If inadequate densities are obtained, larger and/or different types of additional equipment shall be provided by the CONTRACTOR. Hand-operated equipment shall be capable of achieving the specified densities.
- I. Moisture Control Equipment. Equipment for applying water shall be of a type and quality adequate for the work, shall not leak, and shall be equipped with a distributor bar or other approved device to assure uniform application. Equipment for mixing and drying out material shall consist of blades, discs, or other approved equipment.
- PART 3 EXECUTION

3.01 GENERAL

- A. The work shall be constructed to the lines, grades, elevations, and cross sections indicated on the plans, and specified herein. Graded surfaces shall present a neat, uniform appearance upon completion of the work.
- B. It shall be the CONTRACTOR's responsibility to maintain adequate safety measures and working conditions, and to take measures necessary during the performance of the work to protect areas affected by the work from storm damage, flood hazard, caving of trenches and embankments, and sloughing of material. It shall be the CONTRACTOR's

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responsibility to maintain completed areas until the entire project area is in compliance with the Contract Documents.

- C. Utility lines and structures, which are to remain in service, shall be protected from damage during construction. Where utility lines, underground pipes and conduits, or structures not shown on the drawings are encountered, the CONTRACTOR shall report them to the OWNER before proceeding with the work. The CONTRACTOR shall bear the cost of repair or replacement of utility lines or structures, which are broken or damaged by his operations.
- D. No fill shall be placed on spongy, porous, or wet subgrade.
- E. No fill or work shall be placed on subgrades prior to testing without the OWNER's approval, except in pipe trenches.

3.02 DUST CONTROL

- A. The CONTRACTOR shall take steps to prevent and reduce dust arising from the construction activity. He shall have adequate water trucks to water, as necessary, the areas where dust may arise. He shall cooperate fully and water immediately, when directed by the OWNER. The use of water will not be permitted when it will result in or create hazardous or objectionable conditions such as, but not limited to, flooding or pollution.
- 3.03 CARE OF DRAINAGE WATER
 - A. CONTRACTOR shall remove drainage water from the construction operations, and shall prevent storm water and wastewater from reaching the construction area. The CONTRACTOR shall be responsible for any damages to persons or property on or off the construction site caused by storm water flows that were diverted due to construction operations.
 - B. Grading shall be done as necessary to prevent surface water from flowing into excavations. Water accumulating therein shall be removed by pumping or by other approved/accepted methods.

3.04 EXCAVATION

- A. The CONTRACTOR shall perform all excavation of every description to the lines and grades shown on the plans. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from the banks of the trench to prevent slides or cave-ins. All excavated materials not required or not suitable for backfill shall be removed and properly disposed of by the CONTRACTOR.
 - 1. The CONTRACTOR shall not over-excavate materials beyond indicated subgrade elevations or dimensions without specific direction. All over-excavation shall be at the CONTRACTOR's expense. Such unauthorized excavation and its subsequent method of remediation include:
 - a. Under footings or foundation bases, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom, without altering required top elevation as approved by the OWNER.

- b. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations unless otherwise directed by the OWNER.
- 2. In areas where the trench bottom is not excavated in accordance with the plans due to rock or other hard underlying materials, the pipe shall be encased in concrete.
- B. Additional Excavation. When excavation has reached required subgrade elevations, the OWNER will make an observation of conditions.
 - 1. If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and replace the excavated material as directed by the OWNER. Unsuitable material shall include organic soil, soft or loose bearing material, saturated soil, vegetation, cinders, debris, trash, and other material of inadequate bearing.
 - 2. Removal of unsuitable material below required subgrade elevations and its replacement as directed will be incidental to the pipeline work at no additional cost to the OWNER.
- C. Stability of Excavations. Slope sides of excavations shall comply with codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- D. Safety Requirements. Provide and maintain barricades, flags, torches, and other safety devices as required by local, State, and Federal codes and conduct work to create minimum inconvenience to the public. Temporary suspension of work does not relieve responsibility for the above requirements.
- E. Sheeting, Shoring, and Bracing. Provide materials for sheeting, shoring, and bracing, such as sheet piling, uprights, stringers and crossbraces, in good serviceable condition.
 - 1. Establish requirements for trench shoring and bracing to comply with codes and authorities having jurisdiction.
 - 2. Maintain shoring and bracing in excavations. Carry down shoring and bracing as excavation progresses.
- F. Dewatering. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.
 - 2. Convey water removed from excavations and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversions outside excavation limits. Do not use trench excavations as temporary drainage ditches.
 - 3. Dewatering devices shall be provided with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the OWNER will order immediate shutdown, and remedial measures will be the responsibility of the CONTRACTOR.
- 4. Upon completion of the dewatering work, the CONTRACTOR shall remove all equipment and leave the construction area in a neat, clean and acceptable condition.
- 5. Maintain ground water table at least 12 inches below the finished excavation subgrade.
- G. Excavation for Structures.
 - 1. Refer to Section 02220 Structural Excavation, Fill & Backfill.
- H. Trench Excavation
 - 1. Trench Walls. Trench walls shall be vertical and the practice of undercutting at the bottom or flaring at the top will not be permitted unless at the OWNER's direction. In special cases where trench flaring is permitted and directed by the OWNER, the trench walls shall remain vertical to a depth of at least one-foot above the top of the pipe.
 - 2. Minimum Width of Trench. The minimum width of pipe trenches, measured at the crown of the pipe, shall be not less than 18 inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench shall be not less than 18 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width shall be exclusive of trench supports and not greater than the width at the top of the trench.
 - 3. Maximum Width of Trench. The maximum allowable width of trench for pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches may be used without special bedding if the CONTRACTOR, at his expense, furnishes pipe of the required strength to carry the additional trench load. Such modifications shall be submitted to the OWNER and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the Contract Documents, or by the written approval of the OWNER, the CONTRACTOR, at his expense, shall cradle the pipe in concrete, or other pipe bedding material approved by the OWNER.
 - 4. Maximum Length of Open Trench. Except with special permission by the OWNER, only that amount of pipe construction will be permitted which can be completed in one day, including excavation, construction of pipeline, and backfill in any one location. Maximum length of open trench shall never exceed 600 feet. This length shall include open excavation, pipe laying, and appurtenant construction and backfill, which has not been temporarily resurfaced. Surcharge loads due to construction equipment shall not be permitted within 5 feet of the top of excavated slopes.
 - 5. Excess Trench Excavation. Whenever over-excavation occurs, the under-cut trench shall be restored to grade, to the satisfaction of the OWNER, by replacement of excavated material compacted to the same density as the surrounding natural ground.

3.05 PIPE BEDDING

- A. The CONTRACTOR shall excavate at least a depth of 6" below the pipe for the full width of the trench. If conditions are stable, the CONTRACTOR shall backfill the trench with bedding material from the bottom of the trench to the bottom of the pipe. If conditions are unstable, the CONTRACTOR shall over-excavate to a depth satisfactory to the observer and then backfill from the bottom of the trench to a point 6 inches below the bottom of the pipe with gravel subgrade filler. The CONTRACTOR shall then use bedding material to backfill from the top of the gravel subgrade filler to the bottom of the pipe.
- B. Before pipe is lowered in place, the trench bottom or bedding shall be prepared so that each pipe will have a firm and uniform bearing over the entire length of the barrel and a width as per drawing the trench width. Adjustments in line and grade shall be made by scraping away or filling and tamping in under the barrel of the pipe. Wedging or blocking is not permitted.
- 3.06 BACKFILLING (ALL CLASSES)
 - A. Backfill areas to contours and elevations.
 - B. Employ a placement method that does not disturb newly installed pipe or existing facilities and structures in trenches.
 - C. If backfilling against unsupported walls is necessary, backfill simultaneously on each side of wall until supports are in place.
 - D. Slope grade away from exposed structures minimum 2 inches in 10 feet, unless noted otherwise.
 - E. Make grade changes gradually. Blend slopes into level areas.

3.07 BACKFILLING PIPE TRENCHES

- A. From the top of the embedment, the trench or excavation shall be backfilled with select material or excavated material approved by the OWNER's Representative. No excavated material or excessively large rocks (largest dimension greater than 3 inches) or debris of any sort are to be placed into the backfill. No appreciable weight of any sort, other than backfill, shall be allowed on the pipe until it has been covered to such a depth that will prevent damage to the pipe and joints. The top six (6) inches of backfill shall be topsoil free from rock outside of paved area. This shall be increased to the top twenty-four (24) inches in areas where farming activities are observed to be taking place.
- B. Excavated material which is unsuitable for backfilling and excess material shall be disposed of as specified in Section 02227 Waste Material Disposal.
- C. Method of Compaction:
 - 1. The CONTRACTOR shall provide a method of compaction of material 12-inches or more above the pipe. Backfill material shall be compacted in layers from six to eight inches in thickness of loose fill. This material may be placed mechanically or by other means to provide at least 98% of maximum dry density in all areas at 0 to 4

percent above optimum moisture or the compaction indicated on the Drawings. Where the soil PI is less than 20, the compaction moisture content shall be within <u>+</u> 3% of optimum. Such material shall be tested by the CONTRACTOR and reports submitted and approved/accepted by the ENGINEER and OWNER before continuing.

- 2. The initial test section shall be a minimum of 100 linear feet. Material not meeting required compaction shall be removed and replaced at no additional cost to the OWNER. See Item 6 below for deep-fill requirements.
- 3. Jetting and flooding. Not allowed.
- 4. Backfill Under Road, Concrete Slabs, and Related Items. The backfill for trenches under roads, concrete slabs, and related items shall be high strength fast fix flowable fill.
- 5. Backfill in Structural Excavation Zone. The backfill for pipeline trenches located in the zone of excavation for structures shall be in accordance with Section 02220 Structural Excavation, Fill and Backfill.
- 6. Fill depths between 15' to 25' shall be compacted to 98% ASTM D698. Fill depths between 25' to 35' shall be compacted to 100% ASTM D698.

3.08 FLOWABLE FILL

- A. Flowable fill shall be used as backfill in areas as required in the plans. The following procedures shall be employed while using flowable fill:
 - 1. Flowable fill shall be placed in a trench or excavation prepared for the pipe to the depth shown on the plans.
 - 2. Consistency. Consistency shall be tested by filling an open-ended three-inch (3") diameter cylinder six inches (6") high to the top with flowable fill. The cylinder shall be immediately pulled straight up and the correct consistency of the flowable fill shall produce a minimum eight-inch (8") diameter circular-type spread with no segregation.
 - 3. Batch Mixing and Transportation. Materials are to be measured by weight and/or volumetric methods. The flowable fill may be mixed in a central concrete mixer, a ready mix truck, or by other acceptable methods. The flowable fill shall be transported to the point of placement in a revolving drum mixer or in an agitator unit.
 - 4. Placing. For pipe trench backfill, provide bulkheads at units of fill placement sufficient to confine backfill. Bulkheads are to be structural.
 - 5. Covering. Flowable fill may be covered when it adequately supports the weight of construction equipment, no less than 24 hours after completion of placement.

3.09 EARTH BACKFILL AROUND STRUCTURES

- A. Refer to Section 02220 Structural Excavation, Fill & Backfill
- 3.10 PLACEMENT OF FILL AND BACKFILL
 - A. General

- 1. All select backfill, backfill and fill required for structures and trenches and required to provide the finished grades shown and as described herein shall be furnished, placed and compacted by the CONTRACTOR.
- 2. Backfill excavations as promptly as work permits, but not until completion of the following:
 - a. Observation by the OWNER of construction below finish grade.
 - b. Observation, testing and recording of locations of underground piping and ductwork.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
 - e. Removal of trash and debris.
 - f. Backfill against foundation walls, only after review by the ENGINEER. Do not damage waterproofing when placing backfill.
- 3. Fill containing organic materials or other unacceptable material shall be removed and replaced with acceptable fill material.
- 4. No material shall be placed when free water is standing on the surface of the area where the material is to be placed. No compaction of material will be permitted with free water on any portion of the material to be compacted. No material shall be placed or compacted in a frozen condition or on top of frozen material. Any material containing organic materials or other unacceptable material previously described shall be removed and replaced with acceptable material prior to compaction.

3.11 COMPACTION

- A. All materials requiring compaction shall be by mechanical means. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and corrective action shall be taken by the CONTRACTOR prior to continued placement.
- 3.12 MOISTURE CONTROL
 - A. During all compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of fill. Maintain moisture content uniform throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement, if required, by sprinkling the fill. At the time of compaction, the water content of the material shall be at optimum moisture content, plus or minus 2 percentage points.
 - B. Do not attempt to compact fill material that contains excessive moisture. Aerate material by blading, discing, harrowing, or other methods, to hasten the drying process.

3.13 FIELD DENSITY AND MOISTURE TESTS

A. The CONTRACTOR and OWNER will determine in-place density and moisture content by any one or combination of the following methods: ASTM D2922 (density of soil and soil aggregate in-place by nuclear methods - shallow depth), D1556 (density and unit weight of soil in-place by sand cone method), D2216 (lab density of water content of soil and rock), D3017 (water content of soil and rock - shallow depth in-place by nuclear methods). CONTRACTOR shall cooperate with OWNER's quality assurance testing work by leveling small test areas designated by the OWNER. CONTRACTOR shall backfill quality assurance test areas at the CONTRACTOR'S expense. The frequency and location of quality assurance testing shall be determined solely by the OWNER. The OWNER may test any lift of fill at any time, location, or elevation. The CONTRACTOR testing program for quality control is referenced in Section 01400 – Quality Control.

3.14 CLEAN-UP

A. Upon completion of the work, rubbish and debris shall be removed from the job site. Construction equipment and implements of service shall be removed, and the entire area involved shall be left in a clean and acceptable condition.

3.15 FIELD QUALITY CONTROL

- A. Site Tests: The ENGINEER will employ a testing laboratory to perform field quality control testing.
 - 1. Testing Laboratory Scope:
 - a. Perform field moisture content and density tests to ensure that the specified compaction of fill materials has been obtained.
 - b. Tests of actual unconfined compressive strength or bearing tests on each stratum.
 - c. Report results of each test to ENGINEER and CONTRACTOR.
 - 2. Required Material Tests:
 - a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.
 - 3. Authority and Duties of Testing Laboratory:
 - a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to ENGINEER and CONTRACTOR. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of ENGINEER and CONTRACTOR to such failure.
 - b. Technician will not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate ENGINEER for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
 - 4. Responsibilities and Duties of CONTRACTOR:
 - a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
 - b. To facilitate testing laboratory, CONTRACTOR shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
 - c. It shall be CONTRACTOR's responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control construction operations by confirmation tests to verify and confirm that

CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.

- d. CONTRACTOR shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
 - i. 200 linear feet of trench fill.
 - ii. 10 cubic yards of select fill.
 - iii. 100 cubic yards of general fill.
 - iv. 50 cubic yards of subbase material.
- 5. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:
 - a. Trenches for Structures, and Underground Facilities (including buried ductbanks):
 - i. In Open Fields: Two locations every 1,000 linear feet.
 - ii. Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
 - iii. Crossing Paved Roads: Two locations along each crossing.
 - iv. Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
 - b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.
 - c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.
 - d. For General Fill: One per 1,000 square feet on every compacted lift.
 - e. Subbase Material: One per 1,000 square feet on every compacted lift.
- 6. Periodic compliance tests will be made by ENGINEER to verify that compaction is complying with the requirements specified, at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall fill and re-compact the excavation after testing is complete.
- 7. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, CONTRACTOR shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at CONTRACTOR's expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by CONTRACTOR.

SECTION 02220

EXCAVATION, BACKFILLING AND COMPACTION FOR STRUCTURES

- PART 1 GENERAL
- 1.01 DESCRIPTION
 - A. This section describes requirements for:
 - 1. Dewatering prior to excavation.
 - 2. The excavation for all structures, backfilling around completed structures and the disposal of all excess excavated material. All operations required for the proper completion of the excavation work, including sheeting, shoring and bracing, dewatering of excavations and compaction of backfill is included.
 - 3. All fill required for completion of the work as shown or specified.
 - 4. Trenching and backfilling for all pipes under structures.

1.02 RELATED WORK

- A. Section 02227 Waste Material Disposal.
- B. Section 02530 Dewatering and Drainage.
- C. Section 03300 Cast-in-Place Concrete.
- 1.03 REFERENCED STANDARDS
 - A. American Society for Testing and Materials (ASTM).
 - 1. ASTM C 33 Standard Specification for Concrete Aggregate.
 - 2. ASTM C 40 Standard Test Method for Organic Impurities in Sands for Concrete.
 - 3. ASTM C 136 Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregate.
 - 4. ASTM C 150 Standard Specification for Portland Cement.
 - 5. ASTM D 4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - 6. ASTM D 1557 Standard Test Methods for Moisture- Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 in (457 mm) Drop.
 - 7. ASTM D 4253 Maximum Density of Soils Using a Vibratory Table.
 - B. U.S. Department of Commerce/National Bureau of Standards: PS-17-Polyethylene Sheeting (Construction, Industrial and Agricultural Applications).
 - C. Texas Department of Transportation: Texas Highway Department Testing Method TEX 113-E
- 1.04 DEFINITIONS
 - A. Compaction:

- 1. All compaction shall be such that the apparent dry density of each layer shall be not less than 98 percent of the maximum dry density as determined by tests as outlined in Texas Highway Department Testing Method TEX 113-E.
- 2. Apply corrections for oversized material to either as-compacted field dry density or maximum dry density, as determined by OWNER.
- B. Optimum Moisture Content:
 - 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 - 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- C. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.
- D. Completed Course: A course or layer that is ready for next layer or next phase of Work.
- E. Lift: Loose (uncompacted) layer of material.
- F. Well-Graded:
 - 1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
 - 2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
 - 3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.
- G. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
 - 1. 1-foot outside outermost edge at base of foundations or slabs.
 - 2. 1-foot outside outermost edge at surface of roadways or shoulder.
 - 3. 0.5-foot outside exterior at spring line of pipes or culverts.
- H. Selected Backfill Material: Materials that OWNER determines to be suitable for specific use.
- I. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- J. Structural Fill: Fill materials as required under structures, pavements, and other facilities.
- K. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.
- 1.05 SUBMITTALS
 - A. Submit the following in accordance with the requirements of the General Conditions and Division 1 General Requirements:

- 1. Testing laboratory reports, as specified or required, to show compliance with Contract Documents for material from off-site locations. The specified tests shall be performed by a certified independent testing laboratory employed and paid by the CONTRACTOR.
- 2. The CONTRACTOR shall retain the services of a Professional ENGINEER, licensed in the State of Texas and having experience in soils engineering, to design and prepare the dewatering plans and excavation plans for all excavations for structures. The plans and calculations shall be sealed by a Professional ENGINEER licensed in the State of Texas. The plans shall include shoring systems, systems to protect existing utilities, slope stability monitoring and dewatering with groundwater monitoring wells for verification.
- 3. Submit a plan for all excavations of a depth 5 feet or greater, with a bottom width less than twice the total depth of the excavation, where an existing structure or utility falls within a 2 horizontal to 1 vertical (2:1) slope from the bottom of the excavation, or where conditions dictate a plan be developed based on the trench safety ENGINEER's analysis.
- 4. Submit details of any proposed dewatering system, including groundwater monitoring wells for verification, slope stability and/or shoring systems to the OWNER prior to proceeding with any excavation.
- B. Notify OWNER when:
 - 1. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
 - 2. Fill material appears to be deviating from Contract Documents
- 1.06 PROTECTION OF FACILITIES
 - A. Before the start of earthwork operations, adequately protect utilities, trees, shrubs and other permanent objects. Costs resulting from damage to permanent facilities due to negligence or lack of adequate protection will be charged to the CONTRACTOR.
 - B. Provide surface drainage during the period of construction to protect the work and to avoid nuisance to adjoining property.
 - C. The CONTRACTOR shall conduct his operations in such fashion that trucks and other vehicles do not create a dirt nuisance in the streets. The truck beds shall be sufficiently tight, and shall be loaded in such a manner that objectionable materials will not be spilled onto the streets. Any dirt, mud, or other materials that are spilled onto the streets or deposited onto the streets by the tires of vehicles shall be promptly cleared away by the CONTRACTOR.
- 1.07 BLASTING
 - A. Blasting will not be permitted.
- 1.08 QUALITY ASSURANCE
 - A. The CONTRACTOR will employ and pay for the services of a testing laboratory, as specified in Section 01400 Quality Control, to perform various site inspections and compaction tests on the compacted material. The CONTRACTOR shall cooperate with

the testing laboratory in performing these inspections and tests. The CONTRACTOR shall notify the OWNER at least 48 hours in advance of the time at which inspections and tests will be required. Any area failing to comply with the Contract Documents shall be reworked as required to conform to the Contract Documents.

1.09 SEQUENCING AND SCHEDULING

- A. Complete applicable Work specified in Section 02200 Site Preparation, Section 02215 Excavation, and Section 02235 Subgrade Preparation, prior to placing fill or backfill.
- B. Backfill around buried vaults or manholes only after structure is set in position, securely anchored, and ready to be backfilled, and OWNER provides authorization to backfill.
- C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 02235 Subgrade Preparation.
- 1.10 OBSERVATION OF EXCAVATIONS
 - A. Notify the OWNER at least 48 hours prior to beginning any excavation so that the OWNER may observe the excavation. Do not place reinforcing steel or concrete in the excavation prior to observation unless the OWNER has given approval to proceed without observation.
 - B. Notify the OWNER at least 48 hours prior to backfilling of pipe trenches. Do not begin backfilling of pipe trenches until all pipe joints have been accepted unless the OWNER has given approval to backfill the trenches without acceptance.
- PART 2 PRODUCTS
- 2.01 SELECT MATERIAL
 - A. Where select material is shown or specified, use an accepted material, free of organic matter and foreign substances, obtained from an accepted off-site source. The material shall have a plasticity index between 4 and 12 and a maximum liquid limit of less than 35 as determined by ASTM D 4318. The materials shall retain a minimum of 48 percent on the No. 200 sieve. Prior to bringing any of the proposed material to the site, submit, for review by the Consulting ENGINEER, an analysis of the proposed material, including a moisture-density relationship curve prepared in accordance with ASTM D 698 by a certified independent testing laboratory employed and paid by the CONTRACTOR.
- 2.02 SAND
 - A. Where sand is shown or specified, use natural sand meeting ASTM C 33 requirements for fine aggregate.
- 2.03 CONCRETE BACKFILL
 - A. Concrete backfill shall conform to Class C (2000 psi) concrete as specified in Division 3 Concrete, Cast-in-Place Concrete.
- 2.04 VAPOR BARRIER MEMBRANE
 - A. Polyethylene sheeting conforming to U.S. Department of Commerce, National Bureau of Standards (NBS), Product Standard PS-17, not less than 10-mil nominal thickness.

2.05 FILTER MATERIAL

- A. Where shown, use a mixture of coarse aggregate or fine aggregate for filter material.
- B. Coarse aggregate shall consist of gravel, crushed gravel or crushed stone and shall have a gradation limit of 3/4-inch to No. 4 complying with ASTM C 33 (Type 7).
- C. Fine aggregate shall consist of natural sand and shall comply with the requirements of ASTM C 33 for fine aggregate.
- 2.06 GRANULAR FILL
 - A. Where shown, coarse aggregate shall consist of gravel, crushed gravel or crushed stone and shall have a gradation limit of 1/2-inch to No. 4 complying with ASTM C 33 (Type 57).
- 2.07 FLEXIBLE BASE
 - A. Where shown, flexible base shall comply with TX DOT Item 247, Type A, Grade 1. Flexible base shall be compacted in maximum 6-inch lifts at or above the optimum moisture content to 98 % ASTM D698.
- 2.08 COMPACTED CLAY CAP
 - A. Where clay caps are shown, clay shall have a PI over 25 and be compacted in 6-inch lifts at optimum to +4% above optimum to 98% ASTM D 698.
- 2.09 BPUB SEWER GRAVEL MATERIAL
 - A. Refer to Section 02217 Excavating, Backfilling and Compaction for Utilities.
- PART 3 EXCAVATION
- 3.01 CLEARING
 - A. Remove shrubs, trees, stumps, roots, underbrush, weeds and other vegetation in the way of new construction, unless otherwise noted on drawing.
 - B. Topsoil consisting of friable material free of vegetation, clay lumps, stones or toxic substances shall be stockpiled in areas, as directed by the OWNER, at the site for use in finish grading.
- 3.02 SLABS ON GROUND
 - A. Slabs at Grade:
 - 1. Top soil and vegetation shall be stripped to a depth of at least six (6) inches to at least 5'-0" beyond the exterior wall line or adjacent sidewalks.
 - 2. Existing soil material remaining shall be removed to a depth of 4'-0" below the original grade to at least 5'-0" beyond the exterior wall line or adjacent sidewalks.
 - 3. The exposed subgrade shall be proof rolled with a fully loaded dump truck weighing at least 20 tons. A minimum of 20 passes shall be performed with passes

alternating in directions perpendicular to each other. Any areas that yield under roller loading shall be undercut and replace with select fill.

- 4. The exposed subgrade shall be scarified to a depth of eighteen (18) inches below the cleared depth and recompacted to 95 percent maximum density as determined by tests as outlined in Texas Highway Department Testing Method TEX 113-E.
- 5. Fill. Upon completion of subgrade preparation, place select material in uniform layers of loose material, six to eight inches in depth, dried or moistened as required to obtain optimum moisture content, and compact each layer as specified. Fill shall be placed while subgrade is at its optimum moisture content.
- 6. A twenty four (24) inch high PI (PI between 20 and 40) clay cap shall be placed to a horizontal distance of 10'-0" beyond the building wall. In areas where sidewalks are adjacent to the building wall, the sidewalk surface is considered part of the "cap" and the clay cap shall extend from the edge of the sidewalk to a horizontal distance of 10'-0" beyond the building wall.
- 7. Final Grade. Conform to lines and grades shown on the drawings.
- B. Slabs Below Grade: Any slab requiring an excavation of 5 feet or greater is deemed to be below grade. Excavate to twelve inches above final subgrade unless specified otherwise. In order to preserve the in-situ moisture of the subgrade, do not excavate the final twelve inches until prior to mud slab construction. If the soil at the time of final exposure and concrete placement is not within one to four percent above optimum moisture content as determined by the OWNER's testing laboratory, the top six inches shall be recompacted at the proper moisture level. Soft and wet areas not achieving compaction will require removal and replacement with select material of at least 12 inches compacted thickness.
- C. Compaction:
 - The subgrade and fill material shall be compacted to a minimum of 95 percent and maximum of 98 percent of maximum density unless specified otherwise at 0 to 4% above optimum moisture as determined by ASTM D 698. The methods used to secure the specified compaction and moisture content will be the CONTRACTOR's responsibility. Wet soils shall be worked by plowing, disking, or scarifying and air drying as required to reduce the moisture content to optimum levels.
 - 2. The compacting equipment and method of compaction shall be such that uniform density will be obtained over the entire area and depth of material being compacted. All fill materials deposited in place by scrapers, dump trucks, drag lines or similar equipment shall be thoroughly broken up before being spread into uniform layers.
- D. Vapor Barrier Membrane:
 - 1. Where specified and slabs below grade, as soon as practical after final grading, while the base material is still at its optimum moisture content, install a vapor barrier membrane over the prepared surface at locations shown on the drawings. Provide membrane in the widest practical seamless widths.
 - 2. Lay the membrane material continuous with the joints lapped six inches in the direction of the concrete placement. Carefully fit the membrane tight around all penetrations.

- 3. Before placing concrete, patch all holes and tears in membrane with patches cemented in place with adhesive. Seal around penetrations for conduit, piping, etc., with cold mastic.
- E. Mud slabs (lean concrete seal slabs) shall be placed after final grading or within 4 hours of the removal of the last 12 inches of an excavation, while the base material is at its optimum moisture content, at locations indicated in Paragraph 3.02.B of this specification or shown in the drawings.

3.03 EXCAVATION

- A. Excavation work shall be unclassified and includes removal of all types of materials encountered without exception. Make excavations to lines and grades indicated on drawings. Complete excavations within the tolerances specified.
- B. Sheeting, Shoring and Bracing:
 - 1. Provide sheeting, shoring and bracing of excavations at locations shown on the drawings and where required to properly and safely complete the work as shown. Construct sheeting, shoring and bracing to prevent the excavation from extending beyond specified or indicated limits, to protect adjacent structures, utilities or improvements and to protect workmen and the public. The design of sheeting, shoring and bracing shall be the responsibility of the CONTRACTOR.
 - 2. Care shall be taken to prevent voids outside the sheeting. If voids are formed, they shall immediately be filled and compacted.
 - 3. After completion of the structure, all sheeting, shoring and bracing shall be removed unless acceptance has been granted by the Consulting ENGINEER, in writing, to leave any or all of it in place. The sheeting, shoring and bracing shall be removed as excavations are backfilled in a manner that will prevent injurious caving of the excavation or damage to the structure.
 - 4. Voids left or caused by removal of sheeting shall immediately be filled with suitable material and compacted.
- C. Dewatering: Maintain excavations dewatered while work is in progress. Prior to beginning excavation, groundwater monitoring wells must be installed by the CONTRACTOR to allow the OWNER's representatives to verify that the site has been dewatered to adequate depths below required excavations. Refer to Section 02530 Dewatering and Drainage for additional requirements.
- D. Structures:
 - Wherever practicable, cut all footing excavations to neat lines with a tolerance of minus one inch or plus one inch, and place concrete to bear against earth sides. Where beams are shown to be monolithic with slabs on ground, shape soil to the profile shown. Excavate a sufficient distance from walls, shafts or similar elements of structures to allow for placing and removing forms and for inspection.
 - 2. Excavate to the elevations shown on the drawings forming a level undisturbed surface free of mud or other soft material. When the bottom of the excavation, at the elevation shown, is not within the foundation bearing material shown on the drawing or is unsuitable for foundation bearing, notify the OWNER. Remove all

pockets of soft or otherwise unstable soils and replace with concrete or with suitable well-compacted soil as directed by the OWNER.

- 3. Fill all unauthorized excessive excavation with concrete at no change in the contract sum.
- 4. Divert surface runoff away from the excavation. Protect all open excavations from rainfall or excessive drying so as to maintain the foundation subgrade in a satisfactory, undisturbed condition. Keep excavations reasonably free of water at all times and completely free of water during placement of concrete. Soils below foundation, which become soft, loose or otherwise unsatisfactory for dewatering or other construction methods shall be removed and replaced with satisfactory material, as directed by the OWNER, at the CONTRACTOR's expense.
- 5. For footings, founded on rock, hard shale or similar material, remove all material. Clean and cut to a firm surface either level, stepped or serrated as shown on the drawings. Clean out seams and fill with concrete at the time footing concrete is placed.
- 6. It should be anticipated that groundwater levels will be present at shallow depths within the clay soils. The CONTRACTOR shall be responsible for the design and installation of a dewatering system to control the groundwater. It is anticipated that a system of well points, ditches, sumps, and pumping will be required to control the groundwater. The CONTRACTOR shall install the dewatering system prior to beginning excavation. The CONTRACTOR shall install monitoring wells to verify that the groundwater has been lowered adequately to prevent hydrostatic blowout.

3.04 BACKFILL

- A. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Use select material for all structural excavation. Deposit backfill in uniform layers and compact each layer as specified.
- B. Backfill at Structures: Place backfill as promptly as practicable after completion of each structure or portion of a structure. The bottom 1/3 of wall height may be backfilled when the walls attain specified 28-day compressive strength. The remaining backfill shall not be placed until roof or floor framing system is completed and reaches specified 28-day compressive strength. Remove concrete forms before starting backfill and remove shoring and bracing as the work progresses. Take care to prevent any wedging action of backfill against the structure. Step cut the slopes at 3-foot intervals bounding the excavation as required to prevent wedging. The select material shall be used in backfilling the excavation for the structures. Select material shall be placed in a wedge extending from the base of the wall to the ground surface on a maximum angle of 45 degrees.
- C. Earth Backfill around Structures: Place earth fill in all areas not designated to be gravel subgrade filler. Place backfill material free of roots, organic matter, trash, and rocks larger than 1-inch diameter. Stop backfill at specified grade. Make allowance for topsoil where required.
- D. Compacting Backfill: Place material in uniform layers of prescribed maximum thickness and wet or dry the material to -2 to +2 percent above optimum moisture content. Backfill placed within 5 feet of the walls shall be hand compacted.

- 1. Regular and Select Material. Place in 6-inch maximum layers, loose measure. Compact between 98 and 100 percent of maximum soil density as determined by TxDOT test method Tex 113-E unless specified otherwise
- 2. Sand and Filter Material. Place in 6-inch maximum layers, loose measure. Compact to not less than 75 percent of relative density as determined by ASTM D 4254.
- 3.05 TRENCH FINAL BACKFILL
 - A. Refer to Section 02217 Excavating, Backfilling and Compaction for Utilities.
- 3.06 DISPOSAL OF EXCESS MATERIAL
 - A. Dispose of excess or unsuitable material as specified in Section 02227 Waste Material Disposal.
- 3.07 FIELD QUALITY CONTROL
 - A. Site Tests: The ENGINEER will employ a testing laboratory to perform field quality control testing.
 - 1. Testing Laboratory Scope:
 - a. Perform field moisture content and density tests to ensure that the specified compaction of fill materials has been obtained.
 - b. Tests of actual unconfined compressive strength or bearing tests on each stratum.
 - c. Report results of each test to ENGINEER and CONTRACTOR.
 - 2. Required Material Tests:
 - a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.
 - 3. Authority and Duties of Testing Laboratory:
 - a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to ENGINEER and CONTRACTOR. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of ENGINEER and CONTRACTOR to such failure.
 - b. Technician will not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate ENGINEER for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
 - 4. Responsibilities and Duties of CONTRACTOR:
 - a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
 - b. To facilitate testing laboratory, CONTRACTOR shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
 - c. It shall be CONTRACTOR's responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control

construction operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.

- d. CONTRACTOR shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
 - 1) 200 linear feet of trench fill.
 - 2) 10 cubic yards of select fill.
 - 3) 100 cubic yards of general fill.
 - 4) 50 cubic yards of subbase material.
- 5. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:
 - a. Trenches for Structures, and Underground Facilities (including buried ductbanks):
 - i. In Open Fields: Two locations every 1,000 linear feet.
 - ii. Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
 - iii. Crossing Paved Roads: Two locations along each crossing.
 - iv. Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
 - b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.
 - c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.
 - d. For General Fill: One per 1,000 square feet on every compacted lift.
 - e. Subbase Material: One per 1,000 square feet on every compacted lift.
- 6. Periodic compliance tests will be made by ENGINEER to verify that compaction is complying with the requirements specified, at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall fill and re-compact the excavation after testing is complete.
- 7. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, CONTRACTOR shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at CONTRACTOR's expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by CONTRACTOR.

DOCUMENT 02221

STRUCTURAL SAFETY SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Work in this section shall consist of furnishing all equipment, materials and labor for a structural safety system meeting appropriate requirements established in the Occupational Safety and Health Administration (OSHA) Safety and Health Regulations, Part 1926, Subpart P - Excavations, Trenching and Shoring, Texas HB 1569, and other applicable regulations.
- 1.02 RELATED WORK
 - A. Specifications:
 - 1. Section 02220 Structural Excavation, Fill and Backfill.
 - 2. Section 02530 Dewatering and Drainage.

1.03 SUBMITTALS

- A. Submit the following in accordance with the requirements of the General Conditions and Division 1 General Requirements:
 - The Contractor shall retain the services of Professional Engineers, licensed in the State of Texas and having experience in soils and structural engineering, to design and prepare the structural excavation safety systems. The plans shall include shoring systems, systems to protect existing utilities, slope stability monitoring and dewatering.
 - 2. Submit a plan for all structural excavations of a depth 5 feet or greater, with a bottom width less than twice the total depth of the excavation, where an existing structure or utility falls within a 2 horizontal to 1 vertical (2:1) slope from the bottom of the excavation, or where conditions dictate a plan be developed based on the structural safety engineers analysis.
 - 3. Submit details of any proposed dewatering system, including groundwatermonitoring wells, slope stability and/or shoring systems to the Owner prior to proceeding with any excavation.

1.04 PROTECTION OF FACILITIES

- A. Before the start of earthwork operations, adequately protect structures, utilities, trees, shrubs and other permanent objects. Costs resulting from damage to permanent facilities due to negligence or lack of adequate protection will be charged to the Contractor. Excavations near existing structures or utilities must be instrumented to verify no impact to existing facilities.
- B. Provide surface drainage during the period of construction to protect the work and to avoid nuisance to adjoining property.

C. The Contractor shall conduct his operations in such fashion that trucks and other vehicles do not create a dirt nuisance in the streets. The truck beds shall be sufficiently tight, and shall be loaded in such a manner that objectionable materials will not be spilled onto the streets. Any dirt, mud, or other materials that are spilled onto the streets or deposited onto the streets by the tires of vehicles shall be promptly cleared away by the Contractor.

1.05 QUALITY CONTROL

A. Engineers responsible for the preparation of the Structural Excavation Safety Plan shall meet the qualifications requirements of Section 01400 - Quality Control.

1.06 STRUCTURAL EXCAVATION PLAN

- A. Structural Excavation Plan: After award, the Contractor shall have a structural excavation plan prepared. This excavation plan must illustrate proposed safety and excavation requirements specifically designed for this project and must be designed, signed, dated and sealed by a Professional Engineer licensed in the State of Texas with professional experience in soil mechanics and design of structural excavation safety systems. The Contractor is responsible for obtaining additional soil borings and soil analysis as required for design. The structural excavation plan is to be designed in conformance with OSHA standards, Texas HB 1569 and other applicable regulations.
- A signed, dated and sealed copy of the structural excavation plan shall be maintained Β. at the project site for the Contractor's use during construction. In addition, a signed, dated and sealed copy of the structural excavation plan shall be maintained at the project site in the contractor's records. No work in excavations in excess of five feet deep is to be performed until this plan is prepared and implemented. The Contractor shall not deviate from the structural excavation plan without written authorization from the engineer who prepared the plan. This written authorization shall be signed, dated and sealed by the engineer. Any changes in the structural excavation plan after initiation of construction will not be cause for extension of time or change order. Contractor accepts sole responsibility for compliance with all applicable safety requirements. The structural excavation plan does not relieve Contractor from responsibility for any or all construction means, methods, techniques and procedures. Furthermore the Contractor shall indemnify the Owner, the Owner's Representatives, and Consulting Engineer from any and all claims due to any property damage or bodily injury (including death) that arises from use or misuse of the structural excavation plan, or from Contractor's negligence in performance of the contract work.

1.07 DEFINITION

- A. For the purposes of this project, a structural excavation is any excavation exceeding a depth of 5 feet that requires vertical or steep slopes that cannot sufficiently ensure the safety of existing structures, utilities or workers.
- PART 2 SPECIFIC REQUIREMENTS
 - A. A suitable earth retention system must be designed, load tested and constructed by a qualified contractor under the direct supervision of a registered professional engineer. The design, implementation, instrumented load testing and monitoring of this system is the responsibility of the Contractor.

2.02 LOAD TESTING

- A. Any structural safety system, shoring or earth retention system that requires the use of tie-back anchors or soil nails must include verification load testing prior to installation of any anchors or production nails. Proof-testing of production anchors or nails will also be required periodically during construction.
- B. Pre-construction verification load tests on individual anchors or nails must be loaded to 200% of the Design Test Load in accordance with acceptable standards and procedures established by the applicable industry. This must include prolonged creep testing at 150% of the Design Test Load. A minimum of four (4) load verification tests must be performed at locations selected by the Owner's representative. Pre-construction load tests must demonstrate that long-term creep will not occur at 150% of the Design Test Load and that the maximum test load exceeds 200% of the Design Test Load.
- C. Proof Testing of Production Nails or Anchors will be required on 5% of the production nails/anchors in each row or a minimum of 1 per row. The test locations shall be designated by the Design Engineer and approved by the Owner's representative. Proof testing of production nails/anchors must be in accordance with acceptable standards and procedures established by the applicable industry. Proof testing of production nails must be performed to at least 150% of the Design Test Load.
- D. Acceptance or rejection of verification load tests, nails/anchors and production nails/anchors will be in accordance with applicable standards for the industry.
- E. All load testing procedures and acceptance or rejection criteria must be included in the Pre-Construction Submittal with the Retention Plan for review and acceptance by the Owner's representative. This submittal must include required grout strength and the proposed grout mix. This submittal must be made at least 6 weeks prior to the start of construction.
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. The structural excavation safety system shall be constructed, installed and maintained in accordance with the details shown in the design prepared by the Contractor's licensed Professional Engineer to prevent death or injury to personnel or damage to structures or utilities in or near these structural excavations. Materials excavated to be stored no closer to the edge of the excavation than one-half the depth of the excavation.
- 3.02 SUPERVISION
 - A. Contractor shall provide competent supervisory personnel at each structural excavation while work is in progress to ensure Contractor's excavation safety methods, procedures, equipment and materials meet the requirements of OSHA standards and the structural excavation plan.
- 3.03 MAINTENANCE OF SAFETY SYSTEM
 - A. The safety system shall be maintained in the condition as specified by the Contractor's Trench Safety Engineer. The Contractor shall take all necessary precautions to ensure the safety systems are not damaged during their use. If at any time during its use a

safety system is damaged, personnel shall be immediately removed from the excavation area and the safety system repaired. The Contractor shall take all necessary precautions to ensure no loads, except those included in the safety system design, are imposed upon the excavation.

3.04 INSPECTION

A. Contractor shall make daily inspection of structural excavation system to ensure that the system meets OSHA requirements and the requirements of the safety plan. Daily inspection is to be made by qualified personnel. If evidence of possible cave-ins, slides or other conditions of concern is apparent, all work in the excavation shall cease until necessary precautions have been taken to safeguard personnel entering the excavation and protect adjacent structures and utilities. Contractor shall maintain permanent record of daily inspections. The Contractor's Structural Excavation Safety Engineer shall make periodic site visits (at the start of each new excavation and at least once per week for all open excavations). Within two (2) days after each visit, the Contractor's Structural Excavation Safety Engineer shall make a written report to the Owner certifying that the structural excavation plan and safety construction practices are being followed. The Contractor's Structural Excavation Safety Engineer shall immediately report any unsafe construction practices to the Owner and Contractor.

3.05 REMOVAL

A. Bed and backfill structural excavation to a point at least one foot above the structure prior to removal of any portion of the structural safety system. Bedding and backfill to be in accordance to other applicable specification items. Backfilling and removal of structural excavation supports shall progress together from bottom of excavation upward. Remove no braces or supports until all personnel have evacuated the excavation. Backfill excavation to within five feet of natural ground prior to removal of entire safety system.

SECTION 02223

TRENCH AND EXCAVATION SAFETY SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work in this section shall consist of furnishing all equipment, materials and labor for a trench and excavation safety system meeting appropriate requirements established in the Occupational Safety and Health Administration (OSHA) Safety and Health Regulations, Part 1926, Subpart P - Excavations, Trenching and Shoring, Texas HB 1569, and other applicable regulations.

1.02 RELATED WORK

- A. Contract Documents:
 - 1. Section 02215 Excavation
 - 2. Section 02217 Excavating, Backfilling, and Compaction of Utilities
 - 3. Section 02220 Structural Excavation, Fill & Backfill
 - 4. Section 02227 Waste Material Disposal
 - 5. Section 02530 Dewatering and Drainage

1.03 SUBMITTALS

- A. Submit the following in accordance with the requirements of the General Conditions and Division 1 General Requirements:
 - 1. The CONTRACTOR shall retain the services of a Professional ENGINEER, licensed in the State of Texas and having experience in soils engineering, to design and prepare the trench and excavation plans for all trench and excavations. The plans shall include shoring systems, systems to protect existing utilities, slope stability monitoring and dewatering.
 - 2. Submit a plan for all excavations of a depth 5 feet or greater, with a bottom width less than twice the total depth of the excavation, where an existing structure or utility falls within a 2 horizontal to 1 vertical (2:1) slope from the bottom of the excavation, or where conditions dictate a plan be developed based on the trench and excavation safety ENGINEERS analysis.
 - 3. Submit details of any proposed dewatering system including groundwater monitoring wells, slope stability and/or shoring systems to the OWNER prior to proceeding with any excavation.
- B. The CONTRACTOR should recognize that failure to dewater excavations prior to excavation to adequate levels below required excavation depths will result in a bearing capacity failure at the base of the excavation. If this occurs, the cost of repair of any excavation base failure will be charged to the CONTRACTOR. The CONTRACTOR must install an adequate number of groundwater monitoring wells in order to verify that adequate dewatering has occurred prior to beginning excavation.

1.04 PROTECTION OF FACILITIES

- A. Before the start of earthwork operations, adequately protect utilities, structures, trees, shrubs and other permanent objects. Costs resulting from damage to permanent facilities due to negligence or lack of adequate protection will be charged to the CONTRACTOR. Excavations near existing structures or utilities must be instrumented to verify no impact to existing facilities.
- B. Provide surface drainage during the period of construction to protect the work and to avoid nuisance to adjoining property.
- C. The CONTRACTOR shall conduct his operations in such fashion that trucks and other vehicles do not create a dirt nuisance in the streets. The truck beds shall be sufficiently tight, and shall be loaded in such a manner that objectionable materials will not be spilled onto the streets. Any dirt, mud, or other materials that are spilled onto the streets or deposited onto the streets by the tires of vehicles shall be promptly cleared away by the CONTRACTOR.

1.05 QUALITY CONTROL

- A. ENGINEERS responsible for design of trench safety systems, structural excavation plans and existing utility and structure protection systems shall be Professional ENGINEERS licensed in the state of Texas. Such ENGINEERS must also demonstrate experience in soil mechanics, structural engineering and design of trench safety systems. Such ENGINEERS shall also submit to the Construction Manager certification of professional liability insurance coverage of at least \$1,000,000.00. Such coverage must not exclude structural design or trench safety design.
- B. ENGINEERS responsible for the preparation of the Trench Safety Plan shall meet the qualifications requirements of Section 01400 Quality Control.

1.06 TRENCH AND EXCAVATION PLAN

- A. Trench and Excavation Plan: After award, the CONTRACTOR shall have a trench and excavation plan prepared. This excavation plan must illustrate proposed trench safety and excavation requirements specifically designed for this project and must be designed, signed, dated and sealed by a Professional ENGINEER licensed in the State of Texas with professional experience in soil mechanics and design of trench safety systems. The CONTRACTOR is responsible for obtaining additional soil borings and soil analysis as required for design. The trench and excavation plan is to be designed in conformance with OSHA standards, Texas HB 1569 and other applicable regulations.
- B. A signed, dated and sealed copy of the trench and excavation plan shall be maintained at the project site for the CONTRACTOR's use during construction. In addition, a signed, dated and sealed copy of the trench and excavation plan shall be maintained at the project site in the CONTRACTOR's records. No work in trenches or excavations in excess of five feet deep is to be performed until this plan is prepared and implemented. The CONTRACTOR shall not deviate from the trench and excavation plan without written authorization from the ENGINEER who prepared the trench and excavation plan. This written authorization shall be signed, dated and sealed by the ENGINEER. Any changes in the trench and excavation plan after initiation of construction will not be cause for extension of time or change order. CONTRACTOR accepts sole responsibility for compliance with all applicable safety requirements. The trench and excavation plan does not relieve CONTRACTOR from responsibility for any or all construction means, methods, techniques and procedures. Furthermore the CONTRACTOR shall indemnify

the OWNER and Consulting ENGINEER from any and all claims due to any property damage or bodily injury (including death) that arises from use or misuse of the trench safety and excavation plan, or from CONTRACTOR's negligence in performance of the contract work.

- 1.07 DEFINITION
 - A. For the purposes of this project, a trench excavation is any excavation whose bottom width is less than twice the total depth of the excavation.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Trench safety system shall be constructed, installed and maintained in accordance with the details shown in the design prepared by the CONTRACTOR's licensed Professional ENGINEER to prevent death or injury to personnel or damage to structures or utilities in or near these trench excavations. Unless otherwise specified elsewhere, materials excavated from trench to be stored no closer to the edge of trench than one-half the depth of the trench.
- 3.02 SUPERVISION
 - A. CONTRACTOR shall provide competent supervisory personnel at each trench while work is in progress to ensure CONTRACTOR's trench safety methods, procedures, equipment and materials meet the requirements of OSHA standards and the trench and excavation plan.
- 3.03 MAINTENANCE OF SAFETY SYSTEM
 - A. The safety system shall be maintained in the condition as specified by the CONTRACTOR's Trench Safety ENGINEER. The CONTRACTOR shall take all necessary precautions to ensure the safety systems are not damaged during their use. If at any time during its use a safety system is damaged, personnel shall be immediately removed from the trench or excavation area and the safety system repaired. The CONTRACTOR shall take all necessary precautions to ensure no loads, except those included in the safety system design, are imposed upon the excavation.
- 3.04 INSPECTION
 - A. CONTRACTOR shall make daily inspection of trench safety and excavation system to ensure that the system meets OSHA requirements and the requirements of the trench safety plan. Daily inspection is to be made by qualified personnel. If evidence of possible cave-ins, slides or other conditions of concern is apparent, all work in the trench shall cease until necessary precautions have been taken to safeguard personnel entering trench and protect adjacent structures and utilities. CONTRACTOR shall maintain permanent record of daily inspections. The CONTRACTOR's Trench Safety ENGINEER shall make periodic site visits (at the start of each new excavation and at least once per week for all open excavations). Within two (2) days after each visit, the CONTRACTOR's Trench Safety ENGINEER shall make a written report to the OWNER certifying that the trench and excavation plan and safety construction practices are being followed. The

CONTRACTOR's Trench Safety ENGINEER shall immediately report any unsafe construction practices to the OWNER and CONTRACTOR.

- 3.05 REMOVAL
 - A. Bed and backfill pipe to a point at least one foot above top of pipe prior to removal of any portion of trench safety system. Bedding and backfilling of the trench shall be performed in accordance with other applicable specification items. Backfilling and removal of trench supports shall progress together from bottom of trench upward. Remove no braces or trench supports until all personnel have evacuated the trench. Backfill trench to within five feet of natural ground prior to removal of entire trench safety system.

SECTION 02227

WASTE MATERIAL DISPOSAL

- PART 1 GENERAL
- 1.01 DESCRIPTION
- 1.02 OFF-SITE WASTE MATERIAL DISPOSAL:
 - A. Waste material disposal consists of trees, stumps, logs, brush, roots, grass, vegetation, humus, rubbish, large rocks exceeding a dimension of 6 inches in any direction, demolished equipment not retained by owner and other objectionable matter from operations such as clearing and grubbing, demolition, excavation and grading. Unless otherwise specified, the contractor is responsible for removal and disposal of waste material in accordance with applicable regulations.
- 1.03 PAYMENT
 - A. No separate payment will be made for handling or disposing waste materials. Include cost of work in contract bid prices.
- PART 2 PRODUCTS
- 1.04 SPECIFIC PRODUCTS ARE NOT REQUIRED.
 - A. Use equipment and materials necessary to properly complete disposal of waste materials.
- PART 3 EXECUTION
- 1.01 OFF-SITE DISPOSAL AREA
 - A. Waste material, which must be removed from the work site, shall be disposed of in accordance with applicable regulations and in a manner as not to damage the Owner or other persons.
- 1.02 ON-SITE TEMPORARY STOCKPILE AREA
 - A. Material may be temporarily stockpiled at a designated area approved by Owner. Grade and slope stockpile for drainage with a maximum 4:1 slope (horizontal to vertical).
- 1.03 FILL PLACEMENT AREA
 - A. Excess excavated material fill shall be disposed of off-site unless otherwise indicated on plans. Excess excavated material suitable for fill, if requested by Owner, shall be placed at the site designated by the Owner. The Contractor shall place, if requested by Owner, the material in 8" maximum layers and compact to at least 95% maximum dry density as determined by ASTM D698. The moisture content shall be between 0 to 4% above optimum moisture.
- 1.04 BURNING
 - A. No burning is permitted.

1.05 EQUIPMENT FLUIDS

A. Contractor's equipment fluids shall be collected during servicing and removed from the site and disposed off-site and in accordance with environmental regulations. Flammable or toxic waste shall be contained and not allowed to be spilled on the ground. Used filters, batteries, machine parts, tires and other waste material shall also be removed from the site and disposed off-site in accordance with environmental regulations.

DOCUMENT 02230

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section included removing surface debris and improvements to be cleared.
- B. This Section also covers clearing and grubbing of the Work site as well as topsoil removal.
- C. This Section depend on the following job conditions to have been met prior to start of site clearing.
 - 1. Locating and protection of existing improvements and utilities.
 - 2. Protection of improvements on adjoining sites not to be disturbed including survey monuments.
 - 3. Providing erosion control measures

1.02 RELATED SECTIONS

- A. Section 02000 Site Work General Information
- B. Section 02103 Site Preparation
- C. Section 02290 Erosion Control During Construction
- D. Section 02260 Topsoil Finishing Grade
- 1.03 SUBMITTAL
 - A. A brief description of site clearing procedures, products to be used including any herbicide and precautionary measures during site clearing.
- PART 2 PRODUCTS
- 2.01 EQUIPMENT
 - A. Equipment used to accomplish work shall comply with requirements of Section 02000 Site Work General Information.
- PART 3 EXECUTION
- 3.01 CLEARING
 - A. Limits of clearing shall be all areas within contract limit lines or as shown on the Drawings or as directed by the Owner's Authorized Representative.
- B.
 Remove structures, paving, stumps, bushes, grass, rubbish, refuse and other deleterious materials from area of work and all unsuitable materials resting on or

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protruding above surface of existing ground that would prohibit normal construction activities. Clear stockpile and storage areas.

- 3.02 GRUBBING
 - A. Limits of grubbing shall coincide with limits of clearing or as shown on the Drawings.
 - B. Grub, excavate roots, stumps, rubbish, and other deleterious materials to a depth of not less than two feet below existing ground. If no further excavation will occur, all excavations made for removal of stumps, trees and rocks shall be filled and compacted with suitable material and graded to conform with surrounding surface.
- 3.03 TOPSOIL REMOVAL
 - A. Topsoil is defined as organic surface soil found to a depth of not more than 6 inches. Satisfactory topsoil is reasonably free of subsoil, stones, and other objects over 2 inches in diameter. Comply with requirements of Section 02200 – Site Preparation and Section 02212 – Finishing Grading.
 - B. Strip topsoil to 6 inches depth and in such manner so as to prevent intermingling with the underlying subsoil or other objectionable material.
 - C. Stockpile topsoil in storage piles in areas where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust and contamination from construction debris. Do no use topsoil for fill or backfill.
 - D. Protect the stockpile as per Section 02290 Erosion Control During Construction.
 - E. Seed the stockpile directed by the Owner's Authorized Representative to prevent erosion.
- 3.04 DISPOSAL OF WASTE MATERIALS
 - A. All timber, logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, shall be completely removed from the Owner's property, except that, when permitted in writing by the Engineer, logs and large stumps may be otherwise disposed of as elected by the Contractor.
 - B. Such permit will state the conditions covering the disposal of such logs and stumps without burning, including the areas of disposal. No burning is permissible.
 - C. The Contractor shall be responsible for compliance with all Federal, state, and local laws and regulations relative to disposal of such materials.
 - D. Disposal of materials in streams will not be permitted and no material shall be piled in stream channels nor along the banks where it might be washed away by floods.
 - E. Timber within the areas to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of the Owner's property, provided all timber and waste material is disposed of in a satisfactory manner in an approved offsite location.

- F. All disposals shall be in strict compliance with the requirements of Section 02000 Sitework General Information, and Section 02227 Waste Material Disposal.
- G. The clearing area shall be protected as per Section 02290 Erosion Control During Construction.

END OF DOCUMENT

SECTION 02235

SUBGRADE PREPARATION

PART 1 GENERAL

1.01 DEFINITIONS

- A. Optimum Moisture Content: As defined in Section 02220 Structural Excavation, Fill and Backfill.
- B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.
- C. Compaction: As defined in Section 02220 Structural Excavation, Fill and Backfill.
- D. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.
- 1.02 SEQUENCING AND SCHEDULING
 - A. Complete applicable Work specified in Section 02200 Site Preparation and Section 02215 Excavation, prior to subgrade preparation.
- 1.03 QUALITY ASSURANCE
 - A. Notify OWNER when subgrade is ready for compaction or whenever compaction is resumed after a period of extended inactivity. Tests for density will be made within 24 hours after compacting operations are completed.
- 1.04 ENVIRONMENTAL REQUIREMENTS
 - A. Prepare subgrade when unfrozen and free of ice and snow.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Keep subgrade free of water, debris, and foreign matter during compaction.
 - B. Bring subgrade to proper grade and cross-section and uniformly compact surface.
 - C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.
 - D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 COMPACTION

- A. Under Earthfill: Compact the upper 6 inches to minimum of 98 percent maximum dry density as determined in accordance with TxDOT Test Method TEX 113-E. Subgrade materials shall be compacted by approved/accepted mechanical tamping equipment.
- 3.03 MOISTURE CONDITIONING
 - A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.
 - B. Wet Subgrade: Aerate material by blading, disking, harrowing, or other methods, to hasten drying process.

3.04 TESTING

- A. Compact subgrade with equipment specified in Article 3.02, COMPACTION to detect soft or loose subgrade or unsuitable material, as determined by OWNER.
- B. Provide testing services as provided in the contract document.

3.05 CORRECTION

- A. Soft or Loose Subgrade:
 - 1. Adjust moisture content and recompact, or
 - 2. Over excavate as specified in Section 02215 Excavation, and replace with suitable material from the excavation, as specified in Section 02220 Structural Excavation, Fill and Backfill.
- B. Unsuitable Material: Over excavate as specified in Section 02215 Excavation, and replace with suitable material from the excavation, as specified in Section 02220 Structural Excavation, Fill and Backfill.

SECTION 02240

LIMESTONE BASE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The section shall govern for a foundation course for surfacing, pavement, or other base courses in conformity with the typical sections shown on the plans and to the lines and grades as established by the OWNER.
- 1.02 SUBMITTALS
 - A. CONTRACTOR shall furnish test results conducted on the material showing the acceptability of the material for use as base when analyzed using the appropriate tests specified hereinafter.
- PART 2 PRODUCTS
- 2.01 MATERIAL
 - A. The material shall be crushed as necessary to meet the requirements hereinafter specified and shall consist of durable stone crushed and/or screened to the required particle size, with or without other approved fine sized material. The material shall be from approved sources.
 - B. Testing of flexible base materials shall be in accordance with the following TxDOT standard laboratory test procedures:

Preparation for Soil Constants and Sieve Analysis Tex-101-E

•	•
Liquid Limit	Tex-104-E
Plastic Limit	Tex-105-E
Plasticity Index	Tex-106-E
Linear Shrinkage	Tex-107-E
Sieve Analysis	Tex-110-E
Los Angeles Abrasion	ASTM C131 (Grade A)

C. Samples for testing the material shall be taken prior to the compaction operations.

D. The material shall be well graded and when properly tested, shall meet the following requirements:

Retained on 1 ³ / ₄ inch sieve	0%
Retained on No. 4 sieve	45 to 70%
Retained on No. 40 sieve	60 to 85%

E. The material passing the No. 40 sieve shall be known as Soil Binder and shall meet the following requirements:

Liquid Limit shall not exceed	40
Plasticity Index shall not exceed	12

- F. The crushed stone shall have an abrasion of not more than forty (40) when subjected to the Los Angeles Abrasion Test.
- PART 3 EXECUTION

3.01 CONSTRUCTION

- A. The flexible base material shall be placed on the approved subgrade in courses not to exceed 6 inches compacted depth. It shall be the responsibility of the CONTRACTOR that the required amount of material be delivered and uniformly spread and shaped. All material shall be moved from the place where it is dumped by cutting into windows, it shall be sprinkled, spread, shaped, and rolled in proper sequence to prevent segregation and as necessary for required compaction.
- B. The surface upon completion shall be smooth and in conformity with typical sections and to the established lines and grades. Any deviation in excess of 1/4 inch in cross section and in length of 16 feet measured longitudinally shall be corrected.
- C. Flexible base shall be compacted to an apparent dry density of not less than 95 percent of the maximum density as determined in accordance with TxDOT Test Method Tex-113-E. Tests for density will be made within 24 hours after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked to meet the density required. Just prior to the placing of any succeeding course of flexible base or surfacing on a previously completed course, the density and moisture of the top 3 inches of flexible base shall be checked and if tests show the density to be more than 2 percent below the specified minimum or the moisture content to be more than 3 percent above or below the optimum, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

SECTION 02290

EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all the necessary materials, labor, tools, equipment, and other incidentals required to design, install, maintain, and remove after construction all temporary erosion control devices shown on the Drawings and specified herein. The purpose of erosion control is to prevent sediment-laden runoff from leaving the construction area at any time.

1.02 STORMWATER POLLUTION PREVENTION PLAN

- A. The Contractor shall submit a Stormwater Pollution Prevention Plan with all documents designed, sealed, and signed by either a Licensed Engineer (Texas), Certified Professional in Erosion and Sedimentation Control (CPESC) or Licensed Landscape Architect.
- B. Additionally, erosion control best management practice inspections can only be performed by Licensed Engineers, CPESC, Certified Erosion, Sediment and Stormwater Inspector (CESSWI) or Certified Inspector of Sediment and Erosion Control (CISEC).
- 1.03 GENERAL
 - A. Comply with applicable requirements of all governing authorities having jurisdiction. These Contract Documents are not represented as being comprehensive, but rather to convey the intent to provide complete slope protection and erosion control for both the project site and the adjacent property.
 - B. Erosion control measures shall be established at the beginning of construction and maintained during the entire length of construction. On-site areas, which are subject to severe erosion, and off-site areas, which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive additional erosion control measures as directed by the Engineer.
 - C. All land-disturbing activities shall be planned and conducted to minimize the size of the area to be exposed at any one time and to minimize the time of exposure.
 - D. Surface water runoff originating upgrade of exposed area shall be controlled to reduce erosion and sediment loss during the period of exposure.
 - E. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving ditch or stream, the Contractor shall install measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream as directed by the Engineer.
 - F. All land-disturbing activities shall be planned and conducted so as to minimize off-site sedimentation damage.

- G. The Contractor shall be responsible for periodically cleaning out and disposing of all sediment once the storage capacity of the drainage feature or structure receiving the sediment is reduced by one-third. The Contractor shall also be responsible for cleaning out and disposing of all sediment and removal and disposal of all erosion control products may be left in place or mulched at the site if approved by the OWNER.
- 1.04 TYPES OF EROSION CONTROL
 - A. Straw Bale Dike: The purpose of a straw bale dike is to intercept and detain small amounts of sediment-laden runoff from relatively small-unprotected areas. This type of system can only be used in conjunction with other devices, such as a silt fence. It is not a stand-alone option.
 - B. Temporary Sediment Control Fence (Silt Fence): A silt fence serves the purpose to intercept and detain water borne sediment from unprotected areas to a limited extent. Silt fences are the most common means of erosion control used.
 - C. Stabilized Construction Exit: The purpose of constructing a temporary stabilized construction exit is to prevent sediment from leaving the project site and becoming a nuisance on a paved street. Install a temporary stabilized construction exit at any point where traffic will be entering or leaving a construction site to a paved surface, thus reducing or eliminating the tracking or flowing of sediment onto the paved surface.
 - D. Curb Inlet Gravel Filter Bags: Gravel filled sandbags positioned to intercept water borne sediment from unprotected storm drain inlets.
 - E. Erosion Control Blankets: An erosion control blanket (ECB) is a geotextile or biodegradable fabric placed over disturbed areas to limit the effects of erosion due to rainfall impact and runoff across barren soil. Matting is used in areas that are difficult to stabilize such as steep slopes, drainage swales or high pedestrian traffic areas.
 - F. Mulch: Mulching provides protection for bare soil by absorbing the energy of each raindrop prior to the point when this energy would dislodge individual soil particles and begin the erosion process. Mulching fosters plant growth by providing insulation from temperature extremes and retaining valuable moisture necessary for proper germination.
 - G. Other Control Devices:
 - 1. Diversion Dike: A temporary diversion dike is a barrier created by the placement of an earthen embankment to reroute the flow of runoff to an erosion control device or away from an open, easily erodible area.
 - 2. Interceptor Swale: A temporary interceptor swale is excavated as required to shorten the length of exposed slope by intercepting runoff. They can also serve as perimeter swales preventing off-site runoff from entering the disturbed area or prevent sediment-laden runoff from entering the disturbed area.
 - 3. Rock Berm: A rock berm is to serve as a check dam in areas of concentrated flow to intercept sediment-laden runoff, detain the sediment and release the water in sheet flow.
 - 4. Sand Bag Berm: A sand bag berm is to intercept sediment-laden water from disturbed areas such as construction in stream beds, create a retention pond, detain sediment and release water in sheet flow.

- 5. Stone outlet Sediment Trap: A stone outlet sediment trap is an impoundment created by the placement of an earthen and stone embankment to prevent soil and sediment loss from the site. A sediment trap is to intercept sediment-laden runoff and trap the sediment in order to protect drainage ways, properties and rights-of-way below the sediment trap from sedimentation. A sediment trap is usually installed at points of discharge from disturbed areas.
- 6. Pipe outlet Sediment Basin: A temporary pipe outlet sediment basin is an impoundment created by the placement of an earthen embankment and an integral pipe spillway structure for the purpose of dewatering the impoundment as well as an emergency spillway structure for heavy flows. A sediment basin is to intercept sediment-laden runoff and trap the sediment in order to protect drainage ways, properties, and rights-of-way below the sediment basin from sedimentation. A sediment basin is usually installed at points of discharge from disturbed areas.
- 7. Settling Tanks: A temporary tank is used to impound discharged water from an open trench or tunneling operation for settlement of sediment-laden water prior to discharge into a storm water ditch or storm water system or waterway. The sediment-laden water must be held in the tank a minimum of two hours to allow settlement of the suspended particles. When sediment occupies 1/3 of the tank capacity, it should be removed. Discharge must be through a filtered opening to reduce suspended sediment volume.

PART 2 PRODUCTS

2.01 STRAW BALE DIKE

- A. Straw bales must weigh a minimum of 50 pounds and be at least 30 inches in length. Use binding wire or nylon string and not jute or cotton binding. Do not use bales for more than three months and replace sooner if structural integrity is lost.
- 2.02 TEMPORARY SEDIMENT CONTROL (SILT) FENCE
 - A. Provide a net-reinforced fence using woven geotextile fabric.
 - B. Fabric. Provide fabric materials in accordance with TxDOT DMS-6230, "Temporary Sediment Control Fence Fabric."
 - C. Posts. Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Soft wood posts must be at least 3 in. in diameter or nominal 2 x 4 in. Hardwood posts must have a minimum cross-section of $1\frac{1}{2} \times 1\frac{1}{2}$ in. T- or L-shaped steel posts must have a minimum weight of 0.95 lb. per foot.
 - D. Net Reinforcement. Provide net reinforcement of at least 14 gauge galvanized welded wire mesh, with a maximum opening size of 2 x 4 in., at least 24 in. wide, unless otherwise shown on the plans.
 - E. Staples. Provide staples with a crown at least $\frac{3}{4}$ in. wide and legs $\frac{1}{2}$ in. long.
- 2.03 STABILIZED CONSTRUCTION EXIT
 - A. Provide crushed aggregate for long and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft, or flaky materials and organic and injurious matter.
- B. Length of construction entrance shall be as required but not less than 50'-0" in length and a minimum of 14'-0" wide.
- C. Coarse aggregate shall be open graded with a size of 4- to 8- inches in diameter.
- D. Provide a light weight (4 oz.) non-woven filter fabric below the ballast to prevent mud and sediment migration.
- 2.04 CURB INLET GRAVEL FILTER BAGS
 - A. Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70%.
 - B. Bags shall be filled with $\frac{3}{4}$ gravel.
 - C. For Curb Inlets: Concrete Masonry Units. Hollow, Non-Load-Bearing Concrete blocks of 1500-2000 psi, 28-day compressive strength concrete shall be used with dimensions of 8" x 6" x6" width, height, and length, respectively.
 - D. For Curb Inlets: Wood Blocks. Wolmanized treated 2" x 4" lumber with the length as per inlet size.
- 2.05 EROSION CONTROL BLANKETS
 - A. Use erosion control blankets (ECB) of geotextile or biodegradable fabric.
- PART 3 EXECUTION
- 3.01 INSTALLATION
 - A. Straw Bale Dike:
 - B. Installation on Soil: Embed each bale in the soil a minimum of four inches. Anchor the bales in place by a minimum of two 2 inch x 2-inch wood stakes or steel posts driven through the bales.
 - C. Installation on Pavement: Secure each bale in place by weights placed on the downstream side of the bale. Anchor all bales together to prevent individual movement of a single bale. Anchors may be made into the pavement only if approved by the Project Manager. This is restricted to areas where the pavement is to be replaced as part of the same Contract.
 - D. Make inspection weekly and after each major storm event. Repair or replace promptly as needed.
 - E. Remove bales when silt reaches a depth of 6 inches.
- 3.02 SILT FENCE:
 - A. Installation on Soil: Set posts a minimum of 1 foot deep and space not more than 6 feet on center. Cut a 6-inch wide trench 6 inches deep at the toe of the fence and backfill with earth or gravel. Overlap fabric a minimum of 3 feet and join such that no leakage or bypass occurs.

- B. Installation on Pavement: Weigh fabric with rock on the upstream side to prevent flow from seeping under the fence.
- C. Make inspection weekly and after each major storm event. Repair or replace promptly as needed.
- D. Remove and dispose of silt when it reaches a depth of half the height of the fence.
- E. Triangular Sediment Filter Dike:
- F. Place dikes in row with the ends tightly abutting the adjacent dike.
- G. Make inspections weekly and after each major storm event. Repair or replace promptly as needed.
- H. Remove and dispose of silt when it reaches a depth of half the height of the dike galvanized steel.
- 3.03 STABILIZED CONSTRUCTION ENTRANCE:
 - A. The minimum length of the stabilized entrance is 30 feet for work that is less than 150 feet from the paved surface and at least 50 feet for all other cases. Thickness is 6 inches. The width cannot be less than the full width of all points of ingress and egress.
 - B. When necessary, clean all vehicles to remove sediment before they enter onto a paved area. Remove all sediment spilled, dropped, washed or tracked onto the paved surface immediately.
 - C. Properly grade the entrance or incorporate a drainage swale to prevent runoff from leaving the construction site.
- 3.04 CURB INLET GRAVEL FILTER
 - A. Place the 2" x 4" treated lumber in front of and parallel with the opening of the inlet.
 - B. Place the Concrete Masonry Units (CMUs) around the inlet to be protected in front of the 2"x4" lumber, with the openings of the CMUs facing the inlet.
 - C. Surround the CMUs with gravel bags, making certain there are no gaps evident between the bags.
- 3.05 EROSION CONTROL BLANKET:
 - A. Erosion control blanket shall be of a type and class appropriate to site-specific requirements as determined by the Engineer. Installed materials shall meet the applicable "Minimum Performance Standards for TxDOT" as published by TxDOT in its "Erosion Control Report" unless materials are otherwise approved by the Owner. Providing compliance with TxDOT standards is the responsibility of the Contractor and may be proven by official listing on the most current annual "Approved Products List for TxDOT" applicable to TxDOT Item 169 Soil Retention Blanket and its Special Provisions.
 - B. Fasteners shall conform to the recommendations shown within the manufacturer's published literature for the approved soil retention blanket. In absence of manufacturer's

recommendation for fasteners, a minimum 11-gauge wire staples 6-inches in length and 1-inch in width shall be used.

C. Prior to the installation of any erosion control blankets, all rocks, dirt clods, stumps, roots, trash and any other obstructions that would prevent the mat from lying in direct contact with the soil shall be removed. Anchor trenching shall be located along the entire perimeter of the installation area. These trenches shall be 6-inches deep and 6-inches wide and the matting shall be laid into the trench then backfilled with compacted soil or gravel. Blankets shall be fastened to the ground according to the manufacturer's instruction. Contractor shall submit staple pattern to the Owner. Installations shall be in accordance with manufacturers recommended guidelines with the exception of the minimum criteria stated herein.

3.06 MULCHING

A. Prior to the placement of any mulch, the area to be protected shall be graded completely in accordance with plans. Fertilization and soil treatment shall then be done prior to placement of mulch with the exceptions of when seed is to be applied by means of hydraulic seeding or when seed is distributed following straw mulch spreading during winter months. Organic mulches may be distributed by hand or by mechanical means, so long as a complete covering is achieved. Straw and hay mulches shall be distributed at the rate of 75-to90-pounds-per-1000-feet of treated area. To be fully effective, straw or hay mulch shall be anchored by means of application of a fiber mulch binder, the application of a synthetic liquid mulch binder or by using a tractor-drawn crimper to punch mulch into the soil.

3.07 GENERAL USES

- A. Bore Pits, Recovery Pits and Isolated Manholes: The retention device must completely surround the excavation. If concrete barriers are installed, the erosion prevention devices should be placed outside of the barriers.
- B. Material Stockpiles and Spoil/Excavated Material Stockpiles: The retention device must completely surround the stockpile on ground or pavement that is level up to a 4 percent slope. On slopes greater than 4 percent, the device may be placed on both ends and the downstream side of the runoff.
- C. Storm Water Inlets and Culverts: Place the retention device in a semicircular pattern around the inlet or culvert opening.
- D. Storm Water Ditches: Place a retention device perpendicular to the flow across the ditch and up either side to a depth at least six inches higher than the anticipated depth of flow. Install a device every 100 lineal feet when the slope of the ditch is no greater than 4 percent and every 50 feet when the slope of the ditch is greater than 4 percent.
- E. Excavated or Stockpiles Material Adjacent to a Ditch Excavation: Place the detention device on either end of the stockpile and along the entire side away from the ditch excavation.
- 3.08 INSTALLATION, MAINTENANCE AND REMOVAL
 - A. The Contractor is responsible for determining what types of erosion controls are required and where they should be installed. The Owner's Field Representative has the right to

review such installations and their locations to determine if the conditions of this Section are met. In addition, the Owner's Field Representative can require additional controls in areas/he/she feels need attention.

- B. The Contractor is responsible for maintaining all erosion control devices and activities during the course of construction. The Owner's Field Representative has the discretion to inspect the site periodically and if any deficiencies are found, the Contractor must correct to his/her satisfaction.
- C. At the close of the Contract, remove all temporary erosion control devices and restore the site to its original condition, or the condition shown on the Contract Drawings.
- 3.09 DUST CONTROL
 - A. Dust Control of the Contractor's performance of the Work shall be performed by the Contractor by applying water.
 - B. Water shall be provided in the amounts and locations as required, or as ordered by the Engineer.

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Work includes performing earthwork and site grading, including preparation of subgrade for walks, paving and building slabs indicated by the Contract Documents.
- 1.02 RELATED SECTIONS
 - A. Section 02000 Site Work General Information.
 - B. Section 02220 Structural Excavation, Fill, and Backfill.
 - C. Section 02217 Excavation, Backfilling and Compaction for Utilities.
- 1.03 QUALITY ASSURANCE
 - A. Applicable Codes and Standards: Comply with applicable standards, codes and safety requirements of Section 02000 Sitework General Information.
 - B. Soil Compaction Control: Perform compaction of soil materials as specified in Section 02220 Structural Excavation, Fill and Backfill.
 - C. Testing: Owner's Testing Service shall perform testing of soils and compaction as specified in Section 02220 Structural Excavation, Fill and Backfill.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Backfill and Fill Materials outside of Building Foundation: Satisfactory soil materials excavated from the site may be used as fill and backfill as long as they meet all specified properties, except do not use materials containing stone, rock or gravel larger than 4" in any dimension against walls or in trenches. Do not use soil containing any objectionable material that may be encountered, such as rock, peat, silt, muck, organic material, debris, or other extraneous material.
 - B. Borrow: Additional material required as fill or backfill shall be select fill as furnished by Contractor and approved by the Engineer from off-site sources. Such burrow material shall be soil free from organic matter, debris and of any appreciable amount of gravel or stone particles more than 4 inches in greatest dimension, of such gradation as to permit thorough compaction.
 - C. Foundation Fill: Soil materials to be used, for building foundation fill shall be supplied at no cost by the OWNER from pre-stabilized soils stockpiled on the site. The Contractor shall bear all costs of transportation from this source to the building site.

2.02 COMPACTION EQUIPMENT

- A. Provide compaction equipment of suitable size and number, and in satisfactory working condition to complete work on schedule.
- B. Use sheepsfoot rollers, pneumatic tired roller, tampers, or other compaction equipment capable of obtaining required density throughout entire layer being compacted.
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Excavation consists of removal and disposal of all materials encountered to obtain required subgrade elevations.
 - B. Classifications of Excavation: All excavation shall be unclassified.
 - C. Unauthorized Excavation: Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations without specific direction of Engineer. Replace unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Engineer.
 - D. Material Storage: Stockpile excavated materials classified as satisfactory soil material where directed, until required for fill. Place, grade and shape stockpiles for proper drainage.
 - E. Excavation for Pavement, Walks, Curbs and Gutters: Cut ground under pavement to comply with cross sections, elevations and grades as shown on Drawings.
 - F. Excavation for Ditches: Cut ditches to cross-sections and grades as shown on Drawings. Deposit excavated materials a sufficient distance from edge of ditches to prevent cave-ins or material falling or sliding into ditch. Keep ditches free of an accumulation of leaves, sticks or other debris until final acceptance of Work.
 - G. Excavation for Buildings: Existing soils shall be removed to a depth of not less than 12 inches below existing grade elevation. The exposed soils shall be inspected by the Engineer to determine the location and extent of unsuitable soils that should be undercut. Inspection shall be done by proof rolling with a heavily loaded dump truck or similarly loaded rubber tired vehicle to search out soft areas.
 - H. Removal of Unsatisfactory Soil Materials: Excavate unsatisfactory soil material encountered to depth as directed by Soils Engineer.
 - I. Such additional excavation, provided it is not due to fault or neglect of the Contractor, will be measured as directed by Soils Engineer and paid for by OWNER as a change in work.
 - J. Where removal of unsatisfactory soils materials is due to fault or negligence of Contractor in his performance or earthwork and site grading operations, excavate resulting unsatisfactory soil material and replace with compacted satisfactory soil material as required, at no cost to OWNER.

3.02 COMPACTION

- A. Perform compaction of soil materials using suitable soil compaction equipment for materials to be compacted and work area location.
- B. Control soil compaction during construction for compliance with percentage of maximum density as specified.
- C. Percentage of Maximum Density: Provide not less than percentages of maximum density of specified moisture content as specified in Section 02220 Structural Excavation, Fill and Backfill.
- D. Moisture Control
 - 1. Provide equipment capable of adding measured amounts of moisture to soil material as determined by moisture-density relation tests. Maintain actual moisture content in soil material at time of compaction to within limits specified. Moisture will be added to the excavation area when required, not to the embankment as placed.
 - 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified percentage of maximum density.

3.03 BACKFILL AND FILL

- A. Backfill consists of placement of specified backfill material in layers, in excavations to required subgrade elevations, for each area classification listed below.
- B. Fill consists of placement of specified fill materials, in layers, over ground surface to required elevations, for each area classification listed below.
- C. Provide satisfactory soil materials for backfill and fill, free of rock or gravel larger than 6 inches in dimension, debris, waste, frozen materials, vegetable matter, and other deleterious matter. Use excavated material that has been sampled, tested and approved as satisfactory soil material.
- D. Backfill excavations as promptly as work permits, but not until completion of all inspection, testing, and approval.
- E. Ground Surface Preparation:
 - 1. Remove vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up all surfaces below fills so that fill material will bond with existing surface.
 - 2. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break-up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
- F. Placement and Compaction: Place backfill and select fill materials in layers not more than 8 inches in loose depth. Before compaction, moisten or aerate each layer as necessary to maintain optimum moisture content range of soil material. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or select fill material that is muddy, frozen or contains frost or ice.

3.04 GRADING

A. General

- 1. Uniformly grade all areas within limits of site grading under this Section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- 2. Degree of finish required will be that ordinarily obtainable from a blade grader.
- B. Ditches: Finish ditches to ensure thorough drainage of subgrade surfaces at all times. Conduct final rolling operations to produce a hard, uniform and smooth cross-section.
- C. Grassed and Planting Areas: Finish areas to receive topsoil to within not more than 0.10" above or below required subgrade elevations, compacted as specified, and free from irregular surface changes.
- D. Walks and Paving: Shape surface of areas under walks and pavement in line, grade and cross-section, with finish surface not more than 0.2' above or below required subgrade elevation, compacted as specified, and graded to prevent ponding or water after rains. Include such operations as plowing, disking, and any moisture or serrating required to provide optimum moisture content for compaction.
- E. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil materials. Shape to line, grade and cross-section as shown on Drawings.

3.05 MAINTENANCE

- A. Protection of Graded Areas
 - 1. Protect newly graded areas from traffic and erosion, and keep free of trash and debris.
 - 2. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction. Use hand tamping for recompaction over underground utilities, if any.

3.06 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Removal from OWNER's Property
 - 1. Remove all waste materials, including excavated material classified as unsatisfactory soil material (spoil), trash and debris, from OWNER's property and legally dispose of it.
 - 2. Excess clean (free from organic matter and debris), unregulated or noncontaminated soil shall be hauled to a disposal location on the County property to be determined by the Owner.

END OF DOCUMENT

DEWATERING AND DRAINAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section provides for furnishing all labor, materials, equipment, power and incidentals, and for performing all operations necessary to dewater, drain and maintain excavations and other work as necessary for construction. Included are installing, maintaining, operating and removing pump systems, culverts, channels and other approved devices for removal of standing water, surface drainage and seepage from excavation or other work.
- B. No separate payment will be made for drainage control and pumping.
- C. Some shutdowns will not be absolute. The CONTRACTOR shall be responsible for dewatering of seepage and leakage past any existing valve, wall, structure or gate.
- 1.02 RELATED WORK
 - A. Section 02217 Excavating, Backfilling and Compaction for Utilities
 - B. Section 02220 Structural Excavation, Fill and Backfill

1.03 SUBMITTALS

- A. Submit a groundwater control plan, developed and sealed by a licensed Professional ENGINEER in the State of Texas with professional experience in soil mechanics and design of dewatering systems. The dewatering plan shall outline the CONTRACTOR's means and methods for controlling groundwater including the location of all proposed groundwater monitoring wells for verification prior to beginning excavation. Adequacy and implementation of the plan is the sole responsibility of the CONTRACTOR. The groundwater control plan will be maintained in the OWNER's and ENGINEER's file for reference purposes only. No review will be made nor does the OWNER or ENGINEER assume any responsibility.
- 1.04 QUALITY CONTROL
 - A. CONTRACTOR shall retain a Professional ENGINEER to evaluate groundwater conditions and design appropriate dewatering systems. The CONTRACTOR shall install an adequate number of groundwater monitoring wells to demonstrate that dewatering has occurred to adequate depths below all excavations prior to beginning excavation as verified by the OWNER's designated representative.
- 1.05 CONTRACTOR'S RESPONSIBILITY
 - A. Assume sole responsibility for dewatering systems and for all loss or damage resulting from partial or complete failure or protective measures.
 - B. CONTRACTOR shall be responsible for design of dewatering and drainage system.

PART 2 PRODUCTS

- 2.01 MATERIALS AND EQUIPMENT
 - A. Select equipment and material as appropriate for the intended use.
- PART 3 EXECUTION
- 3.01 DEWATERING
 - A. Furnish, install, operate and maintain all necessary pumping for dewatering the various parts of the work and for maintaining free of water the parts of the work as required for construction operations, inspections and safety.
 - B. Continue dewatering in all required areas, until the area has been completed and accepted by the OWNER.
- 3.02 SPECIFIC REQUIREMENTS
 - A. The CONTRACTOR must take all necessary means to control groundwater inflow and protect the foundation soils below the pipeline, plant improvements and all associated structures and utilities. This may require installation of deep wells, pumped sumps, and possibly well points.
 - B. The CONTRACTOR shall retain a Professional ENGINEER to review site conditions and excavation depths and recommend further means and methods to control groundwater and hydrostatic uplift pressures below excavations, to meet the following requirements:
 - 1. Lower the piezometric groundwater level to at least two (2) feet below the lowest point in the excavation. This level must be maintained until all construction in the area has been completed. Adequate dewatering must be demonstrated by the CONTRACTOR and verified by the OWNER's representative prior to beginning all excavations. Additional pumped sumps and cut-off trenches will be required around the perimeter of the excavation and along the alignment of associated pipelines to maintain a dry working surface during construction and after periods of rain.
 - 2. A dry working surface must be maintained during construction and after each rain. A dry working surface must be verified by the OWNER's representative prior to placement of proposed slab construction.

3.03 REPAIR OF DAMAGE

A. Assume full responsibility for all loss and damage due to inadequate dewatering prior to excavation or as a result of flood, rising water or seepage in any part of the work. Repair any damage to partially completed work from these or other causes by failure or lack of adequate dewatering or drainage facilities.

TEMPORARY BYPASS PUMPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Under this item the Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc., to implement a temporary pumping system for the purpose of diverting the existing flows around the work areas for the duration necessary to construct or modify the designated structures.
- B. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- 1.02 RELATED WORK
 - A. Section 01030 Construction Sequencing.

1.03 SUBMITTALS

- A. The Contractor shall prepare a specific, detailed description of the proposed pumping system and submit it for review by the Engineer.
- B. The Contractor shall submit to the Owner detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with code requirements. No construction shall begin until all provisions and requirements have been reviewed and approved by the Engineer. The plan shall include but not be limited to details of the following:
 - 1. Staging areas for pumps;
 - 2. Sewer plugging method and types of plugs;
 - 3. Number, size, material, location and method of installation of suction piping;
 - 4. Number, size, material, method of installation and location of installation of discharge piping;
 - 5. Standby power generator size, location;
 - 6. Downstream discharge plan;
 - 7. Method of protecting discharge manholes or structures from erosion and damage;
 - 8. Thrust and restraint block sizes and locations;
 - 9. Any temporary pipe supports and anchoring required;
 - 10. Schedule for installation of and maintenance of bypass pumping lines.

1.04 REFERENCE STANDARDS (NOT USED)

1.05 QUALITY ASSURANCE

A. The Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS

- A. Design Requirements:
 - 1. Bypass pumping systems shall have sufficient capacity to pump flow rates of each lift station being by-passed.
- B. Performance Requirements
 - 1. It is essential to the operation of the existing lift stations that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with Contractor's work, carry it past his work and return it to the existing sewer downstream of his work.
 - 2. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
 - 3. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.
 - 4. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.
 - 5. The Contractor shall protect water resources, wetlands and other natural resources.
 - 6. The Contractor shall be solely responsible for any damages arising from a failure of the bypass pumping system.
 - 7. The Contractor shall return all work areas, including but not limited to, pump placement area, temporary piping routing, and connection points to a condition equal to or better than prior to the placement of temporary systems. Any work associated with this provision will not be paid for separately and should be considered incidental to this item.
 - 8. It is the Contractor's sole responsibility to investigate bypass pumping areas prior to bidding. Contractor will be responsible to coordinate with any property owner's as required. Any temporary facilities required to perform the bypass pumping will be the responsibility of the Contractor. Any temporary facilities required as associated with this specification will not be paid for separately and should be considered incidental to this item.
 - 9. Contractor shall not cut, tap, or use in any other way the existing 30" force main for bypass pumping.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of influent flows.
- B. The Contractor shall provide the necessary stop/start controls for each pump.
- C. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safety diverted around the section to be required. Bypass pumping system will be required to be operated 24 hours per day.
- D. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown.
- E. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.
- F. In order to prevent the accidental spillage of flows all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed. Discharge hose may be approved by the engineer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner and the Engineer.
- B. Contractor shall submit all required notices and notifications per the Specifications.

3.02 INSTALLATION

- A. During all bypass pumping operation, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the Pumping Station and main and all local sewer lines caused by human or mechanical failure.
- B. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewerage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- C. When working inside manhole, force main, wet well, or lagoon, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.

D. Contractor is responsible to maintain access to all public and private facilities.

3.03 FIELD TESTING

A. The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Owner will be given 24 hours' notice prior to testing.

3.04 CLEANING

A. Upon completion of the bypass pumping operation, and after receiving permission from the City, the Contractor shall remove all the piping and restore all property to preconstruction condition.

DISINFECTION OF POTABLE WATER FACILITIES

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. Furnish all labor and materials required to disinfect the potable water facilities.
 - B. The potable water facilities include:
 - 1. Piping which is designated to carry Potable Water (PW), Sample Water (SA), Raw Water (RW), Utility Water (UW), Drain Water (D), or Chlorine Solution (CLS).
- 1.02 SUBMITTALS
 - A. Submit a proposed plan and schedule for water conveyance, cleaning, disinfection and water disposal of disinfected water shall be submitted in writing prior to disinfection procedure and plan for disinfection of potable water facilities.
- 1.03 REFERENCE STANDARDS
 - A. American Water Works Association (AWWA)
 - 1. B300- Hypochlorites
 - 2. C651- Disinfecting Water Mains
- PART 2 PRODUCTS
- 2.01 MATERIALS REQUIREMENTS
 - A. All equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment shall be selected and furnished by the CONTRACTOR.
 - B. Chlorine for disinfection may be in the form of sodium hypochlorite solution or calcium hypochlorite granules.
 - C. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of AWWA B300.
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Disinfection operations shall be scheduled by the CONTRACTOR as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the OWNER.
- 3.02 PROCEDURES
 - A. Pipelines:
 - 1. During installation, the interior of all pipes, fittings and other accessories shall be kept as free as possible from dirt and foreign matter at all times. If, in the opinion

of the OWNER's Representative, the pipe contains dirt or foreign matter that could not be removed during the flushing operation, the interior of the pipe shall be cleaned and swabbed with a bactericidal solution. When pipe laying is not in progress, the open ends of it shall be sealed with watertight plugs. If water has accumulated in the trench, the seal shall remain in place until the trench-water has been removed to such an extent that it will not enter the pipe.

- 2. After completion of hydrostatic pressure tests and prior to disinfection, the pipeline shall be flushed, as thoroughly as possible with the water pressure and outlets available. If feasible, flushing rate should develop a velocity in the pipeline of at least 2.5 fps. If a velocity of 2.5 fps cannot be achieved, the requirements of Paragraph 3.02.A.1 above shall be rigidly enforced. The minimum quantity of water used for flushing shall be in excess of the storage capacity of the pipeline, to ensure that clean water has traversed the entire length of line.
- 3. After flushing has been completed to the point that apparent dirt and foreign matter have been removed from the pipeline, pipeline shall be disinfected in accordance with AWWA C651 as modified herein.
- 4. The pipeline shall be disinfected using the Continuous-Feed Method or Slug Method. Minimum chlorine concentration shall be 50 mg/l for Continuous-Feed Method and 100 mg/l for Slug Method.
- 5. Chlorinated water shall be retained in the pipeline for at least 24 hours for Continuous-Feed Method and 3 hours for Slug Method.
- 6. After applicable retention period, the heavily chlorinated water shall be flushed from the newly laid pipeline at its extremities until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that prevailing in the system or is acceptable for domestic use.

3.03 WATER SOURCE

A. CONTRACTOR shall coordinate with the OWNER for availability of water for testing under this Section. The CONTRACTOR shall make complete and satisfactory arrangements with the OWNER prior to obtaining water for testing purposes. It shall be the responsibility of the CONTRACTOR to provide all equipment necessary to transport the water from the source to the pipeline to be tested. The CONTRACTOR shall make other arrangements if the testing water is not available at the OWNER's facility. The CONTRACTOR shall pay the OWNER for the testing water supplied by the OWNER.

3.04 BACTERIOLOGICAL SAMPLING AND TESTING

- A. After final flushing and before the pipeline and structures are placed in service, a sample or samples shall be collected from the end of the line or the structure and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or the appropriate regulatory agency having jurisdiction. For this purpose, the pipe or the structure shall be refilled with the fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.
- B. The OWNER or OWNER's Designated Agent will perform all sampling for bacteriological tests and will pay for the initial testing to be performed by OWNER or

OWNER's selected laboratory. All subsequent testing, should the initial test fail, shall be paid for by the CONTRACTOR.

3.05 CONNECTIONS TO EXISTING SYSTEMS

A. Where connections are to be made to existing potable water and filtered water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

3.06 DISPOSAL OF CHLORINATED WATER

- A. Dispose chlorinated water in a manner that will protect the public and publicly used receiving waters from harmful or toxic concentrations of chlorine. Disposal shall be in accordance with Federal, State and local requirements.
- B. Do not allow flow into a waterway without neutralizing disinfectant residual.
- C. Refer to the appendix of AWWA C651 for acceptable neutralization chemicals.

WOOD FENCE AND GATES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes the work necessary to furnish and install of wood fences and gates as shown on the drawings and specified herein.
- B. Related Specification Sections include, but are not necessarily limited to:
 - 1. Section 01150 Measurement and Payment
 - 2. Section 01330 Submittals
 - 3. Section 01600 Material and Equipment
 - 4. Section 01640 Contractor's Field Services
 - 5. Section 01650 Facility Startup and Commissioning Services
 - 6. Section 01740 Warranties

1.02 REFERENCES

- A. Reference Standards
 - 1. Reference standards cited in this specification refer to the current reference standard published at the time of the latest revision date logged at the end of this specification, unless a date is specifically cited.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A 123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. A 500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - c. F 1043, Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
 - d. F 1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.03 SUBMITTALS

- A. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories and post foundations
- B. Product data: Manufacturer's catalog cuts indicating material compliance and specified options
- C. Building Permit: All fences over 6 feet
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. General

- 1. Gate hinges and post caps shall be of steel, malleable iron, ductile iron or equal.
- 2. Post tops may be of aluminum.
- B. Slats: Cedar free from all major decay or defects which would weaken or otherwise cause them to be unsuitable for fence slats.
- C. Bottom and Top Rail: Minimum 2-inch x 4-inch x 8-foot cedar stud or match existing.
- D. Corner, Gate, End, or Line Posts
 - 1. Steel Posts
 - a. Steel pipe Type I
 - (i) ASTM F 1083
 - (ii) Standard weight schedule 40
 - (iii) Minimum yield strength: 30,000 psi
 - (iv) Sizes as indicated on Drawings
 - (v) Hot-dipped galvanized with minimum average 1.8 oz/ft2 of coated surface area.
 - b. Steel pipe Type II
 - (i) ASTM F 1043, Group IC
 - (ii) Minimum yield strength: 50,000 psi
 - (iii) Sizes as indicated on Drawings
 - (iv) Protective coating per ASTM F 1043
 - (v) External coating Type B
 - (a) Zinc with organic overcoat
 - (b) 0.9 oz/ft2 minimum zinc coating with chromate conversion coating and verifiable polymer film
 - (vi) Internal coating Type B
 - (a) Minimum 0.9 oz/ft2 zinc or Type D, zinc pigmented, 81 percent nominal coating, minimum 3 mils
 - c. Steel square sections
 - (i) ASTM A 500, Grade B
 - (ii) Minimum yield strength: 40,000 psi
 - (iii) Sizes as indicated
 - (iv) Hot-dipped galvanized with minimum 1.8 oz/ft2 of coated surface area
 - 2. Accessories
 - a. Post caps
 - (i) Formed steel or cast malleable iron weather tight closure cap for tubular posts.
 - (ii) Provide one cap for each post.
 - (iii) Cap to have provision for barbed wire when necessary.
 - (iv) "C" shaped line post without top rail or barbed wire supporting arms do not require post caps.
 - (v) Where top rail is used, provide tops to permit passage of top rail.
 - 3. Setting Materials
 - a. Concrete
 - (i) Minimum 28-day compressive strength of 3,000 psi

(ii) Bagged concrete allowed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions
 - 1. Verify areas to receive fencing are completed to final grades and elevations.
 - 2. Ensure property lines and legal boundaries of work are clearly established.

3.02 INSTALLATION

- A. Wood Fence Framing
 - 1. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
 - 2. Space line posts uniformly at 8 feet on center.
 - 3. Set all posts in concrete.
 - a. Drill holes in firm, undisturbed or compacted soil.
 - b. Drill hole diameter 4 times greater than outside dimension of post (minimum 12 inches).
 - c. Set post bottom 36 inches below surface when in firm, undisturbed soil.
 - d. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
 - e. Place concrete around posts in a continuous pour.
 - f. Trowel finish around post. Slope to direct water away from posts.
 - 4. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.

B. Slats

- 1. Place slats approximately 1 inch above the ground, and on a straight grade between posts by excavating high points of the ground.
- 2. Fasten slats to top and bottom railings with 2 galvanized screws designed for wood fence construction at both the top and bottom rail.

CONCRETE FORMWORK

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. This section defines requirements for design, construction, erection and removal of concrete formwork.
- 1.02 RELATED WORK
 - A. Coordinate the requirements of this section with all other sections of Division 3 Concrete.
- 1.03 REFERENCE STANDARDS
 - A. American Concrete Institute (ACI).
 - 1. ACI 117: Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301: Specifications for Structural Concrete.
 - 3. ACI 347: Guide to Formwork for Concrete.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with all the requirements of the General Conditions and Division 1.
- B. Submit manufacturer's literature, data and installation instructions for all proprietary materials, manufactured form systems, ties and accessories.
- C. Submit proposed method of sealing form tie holes; coordinate with details shown.

1.05 STORAGE AND HANDLING OF MATERIALS

- A. Store materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective waterproof covering, providing for adequate ventilation. Store materials in accordance with all manufacturer's recommendations.
- B. Form lumber shall be delivered to the job site as far in advance of its use as is practical, and shall be carefully stacked clear of the ground in such a manner as to facilitate airdrying.
- C. Handle materials to prevent damage in accordance with the manufacturer's recommendations.
- 1.06 QUALITY ASSURANCE
 - A. Design Criteria for Formwork, Falsework and Shoring
 - 1. The design and engineering of all concrete formwork, including all shoring, bracing and reshoring, shall be the responsibility of the Contractor and shall be performed by an Professional Engineer licensed in the state where the project is located.

- 2. Design for loads, lateral pressure, and allowable stresses as described in ACI 347. Design for all lateral loads and other applicable requirements of controlling local building codes.
- 3. Camber formwork to compensate for anticipated deflection during placement of concrete when required to maintain specified tolerances.
- 4. Design formwork to be readily removed without impact, shock, or damage to concrete surfaces and adjacent materials.
- 5. Design for fresh concrete as the pressure exerted by a liquid weighing 150 pounds per cubic foot. Additionally, the rate of concrete placement, concrete temperature and all other pertinent factors shall be taken into account.
- 6. Design for all construction loads imposed during construction.
- 7. Forms shall have adequate stiffness to maintain mortar-tightness and true final dimensions of member being constructed within specified construction tolerances.
- 8. Falsework and shoring shall be designed to provide required strength and stiffness to insure safety and that no excessive settlement or deformation occurs.
- 9. Falsework and shoring shall be supported on an adequate foundation to provide required strength and stiffness to support the superimposed load without settlement.
- B. Alignment Control & Allowable Tolerances
 - 1. Construct and erect formwork in accordance with ACI 117, ACI 301 and ACI 347.
 - 2. True alignment of walls and other vertical surfaces having straight lines shall be controlled and checked. Forming shall be arranged with provisions for adjusting the horizontal alignment after the form has be filled with concrete. Establish a transit line or other reference so that adjustments can be made to an established line while the concrete is still plastic.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Lumber & Plywood
 - 1. Properly seasoned and of good quality; free from loose or unsound knots, holes, shakes, splits, decay and other imperfections that would affect its strength or adversely affect the finished concrete surface.
 - B. Form Linings
 - 1. Fiberboard: Hardwood finished smooth on one side with minimum thickness of 3/16 inch.
 - 2. Plywood: Conforming to APA HDO; exterior exposure waterproof adhesive with minimum thickness of 3/8 inch.
 - C. Form Release Agent:
 - 1. A ready to use water based material formulated to eliminate or reduce surface imperfections free of kerosene, mineral oils, waxes or resins.
 - 2. Release agent shall not discolor or injuriously affect the finished concrete surface, subsequent coatings or concrete curing.

- D. Coating for Plastic Forms
 - 1. Alkali-resistant gel-coat.

2.02 FABRICATIONS

- A. Forms
 - 1. General
 - a. Chamfers: Provide a chamfer on all exposed edges by using either wooden or plastic chamfer strips. Chamfer strips shall be a forty-five degree right triangle in section with the two shorter sides measuring 3/4-inch.
 - b. Waterproofed Surfaces: At surfaces to be waterproofed, provide formwork with sufficient anchor pattern to facilitate bond of the membrane waterproofing.
 - 2. Smooth Forms:
 - a. Construct formwork with plywood; tempered, concrete-form hardboard; dressed lumber faced with plywood or fiberboard lining; metal; plastic; or metal-framed plywood-faced panel material acceptable to the Engineer to provide continuous, straight smooth surfaces. Form material will be free of raised grain, torn surfaces, worn edges, patches, dents or other defects. Furnish material in largest practical sizes to minimize the number of joints and, when shown on the drawings, conform to the joint system shown. Form material will have sufficient strength and thickness to withstand the pressure of newly placed concrete without bow or deflection.
 - b. Smooth forms will be used on all concrete surfaces exposed to view or liquid in the completed structure.
 - 3. Rough Forms:
 - a. Construct forms of dressed or undressed lumber free of knots, splits, or other defects; plywood; metal; or other material acceptable to the Engineer. Material shall have sufficient strength and thickness to withstand the pressure of newly placed concrete without bow or deflection.
 - b. Rough forms may be used on concrete surfaces that will not be exposed to view or liquid in the completed structure.
- B. Metal Forms
 - 1. All specified requirements for "Forms" regarding design, mortar tightness, geometry, bevels, chamfers, bracing, alignment, removal, re-use, oiling, etc. shall apply equally to metal forms.
 - 2. Metal used for forms shall have adequate thickness to remain true to shape. Clamps, pins and other connecting devices shall be designed to hold the forms rigidly together and allow form removal without injury to the concrete.
 - 3. Bolt and rivet heads on exposed surfaces shall be countersunk.
 - 4. Metal forms that do not present a smooth surface free from rust, grease or other foreign materials that discolor concrete shall not be used.
- C. Slip Forming
 - 1. Slip forming is not permitted.
- 2.03 FORM ACCESSORIES
 - A. Form Ties

- 1. Form ties shall be of the removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.
- 2. Ties of a type intended to be entirely removed shall be coated with an acceptable lubricant to safeguard against damaging the concrete during such removal. The use of wire ties will not be permitted.
- 3. Use removable cones of one-inch by one-inch minimum size on the end of the form tie.
- 4. Grout depressions left in concrete by the cones with non-shrink grout after the ends of the cones have been removed.
- B. Form Sealer
 - 1. Surface sealer that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces when applied to most forms or form liners. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents, environmentally safe, meeting local, state, and federal regulations.

PART 3 EXECUTION

- 3.01 FORM CONSTRUCTION
 - A. General
 - 1. All formwork, scaffolds and work platforms shall be safe and conform to OSHA Requirements.
 - 2. Construct and maintain formwork, complying with ACI 347 and this Section so that it will maintain correct sizes of members, shape, alignment, elevation and position during concrete placement and until concrete has gained sufficient strength. Provide for openings, offsets, sinkages, keyways, recesses, moldings, anchorages and inserts, as required.
 - 3. Construct forms for easy removal without damage to concrete surfaces.
 - 4. Formwork shall be sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
 - 5. Chamfer strips shall be placed in forms to bevel all edges and corners permanently exposed to view, except the top edges of walls and slabs which are shown to be tooled. Edges of formed joints and interior corners shall not be beveled unless shown or specified otherwise. Equipment bases shall have formed beveled edges for all vertical and horizontal corners. Unless otherwise noted, bevels shall be 3/4-inch wide.
 - 6. Form ties shall be employed in such places and at such intervals as to securely hold the forms in position during the placing of concrete, and to withstand the weight and pressure of the wet concrete.
 - 7. Provide temporary openings at the base of column and wall forms and at other points as required to facilitate observation and cleaning immediately before concrete is placed. Temporary opening shall be 2' x 2' in size or as required by Owner's Representative.

- 8. If runways are required for moving equipment, provide for support of runways with struts or legs resting directly on the formwork or structural member. Do not allow runways or supports to rest on reinforcing steel.
- 9. Provide openings below large pipe (over 10" diameter) or large embedments to allow adequate concrete fill and minimize honeycombs and voids.
- 10. Construct forms with such care as to produce concrete surfaces which will not have unsightly or objectionable form marks in exposed concrete surfaces. Forms shall have all contact surfaces thoroughly cleaned before reuse.
- B. Forms for Surfaces Exposed to View or Liquids:
 - 1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Form ties shall be uniformly spaced and aligned in rows.
 - 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
 - 3. Form molding shapes, recesses and projections with smooth-finish materials and install in forms with sealed joints to prevent displacement.
 - 4. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines. Provide all exterior exposed corners with 3/4-inch chamfer.
 - 5. Arrange facing material in an orderly and symmetrical fashion. Keep the number of seams to a practical minimum. Support facing material adequately to prevent deflection in excess of allowable tolerances.
 - 6. For flush surfaces exposed to view in the completed structure, overlap previously placed hardened concrete with form sheathing by approximately 1-inch. Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.
- C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finish slab surface. Provide and secure units to support types of screeds required.
- D. Surface to Receive Membrane Waterproofing: Provide chamfers for external corners in concrete surfaces that will be covered with membrane waterproofing. Provide a continuous reglet at line of top of membrane waterproofing on vertical surfaces. Coordinate location with waterproofing applicators.

3.02 TOLERANCES

- A. Construct formwork so that concrete surfaces will conform to tolerance limits as listed in ACI 117, ACI 301 and ACI 347.
- B. Establish sufficient control points and bench marks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the project.
- 3.03 ADJUSTMENTS OF FORMWORK
 - A. Use wedges or jacks to provide positive adjustment of shores and struts. Wedges used for final adjustment of forms should be fastened in position after final inspection and before concrete placement.

- B. Securely brace forms against lateral deflections. Prepare to compensate for settling during concrete placement.
- C. For wall openings, construct wood forms that facilitate any necessary loosening to counteract swelling of forms.

3.04 PREPARATION OF FORM SURFACES

- A. Before placing concrete, clean surfaces of forms and embedded materials. Remove accumulated mortar, grout, rust and other foreign matter.
- B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material used in strict accordance with the Manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.
- C. Other than retained-in-place metal forms, forms for unexposed surfaces may be wet with water immediately before concrete placement in lieu of coating. One exception is that when a possibility of freezing temperatures exists, use of a coating is mandatory.

3.05 REMOVAL OF FORMS

- A. Forms shall not be removed until the concrete has adequately hardened and set. Clamps or tie rods may be loosened twenty-four (24) hours after the concrete is placed; ties, except for a sufficient number to hold the forms in place, may be removed at that time.
- B. Forms on vertical surfaces, when repair of surface defects or finishing is required before concrete is aged, may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed provided that concrete has hardened sufficiently to resist damage from removal operations and provided the removal of these forms will not disturb members supporting the weight of the concrete.
- D. All forms and shoring used to support weight of concrete or any construction loads shall remain in place until concrete has reached the minimum strength specified for removal of forms and shoring. In no case shall forms be removed in less than 4 days.

3.06 REMOVAL STRENGTH

- A. Control Tests: Suitable strength control tests will be used as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs, and other structural members.
 - 1. Field-Cured Test Cylinders. When field-cured test cylinders reach the specified removal strength, formwork or shoring may be removed from the respective

concrete placements. Strength data from field-cured test cylinders shall be furnished by the Contractor.

- 2. Laboratory-Cured Test Cylinders. When concrete has been cured as specified for cast-in-place concrete for the same time period required by laboratory-cured cylinders to reach specified strength, the formwork or shoring may be removed from respective concrete placements. Determine the length of time that the concrete placement has been cured by totaling the number of days or fraction of days, not necessarily consecutive, during which the air temperature surrounding the concrete is above 50 degrees F and the concrete has been damp or thoroughly sealed against evaporation and loss of moisture.
- B. Compressive Strengths: The minimum concrete compressive strengths for removal of all formwork supporting the weight of concrete shall be 75 percent of the specified minimum 28 day strength of the class of concrete involved.

3.07 RESHORING

- A. When reshoring is permitted or required, plan operations in advance and secure approval of such operations. While reshoring is under way, keep live load off the new construction. Do not permit concrete beams, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at the time of reshoring.
- B. Place reshores as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs. Tighten reshores to carry the required loads without overstressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength.
- C. Floors supporting shores under newly placed concrete shall have their original supporting shores left in place or shall be reshored. The reshores shall be located directly under a shore position above unless other locations are permitted. Extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.
- D. Reshoring shall comply with ACI 301 and ACI 347.

3.08 FORM REUSE

A. Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return to original condition.

CONCRETE REINFORCEMENT

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. This section specifies requirements for all concrete reinforcement.
- 1.02 RELATED WORK
 - A. Coordinate the requirements of this section with all other sections of Division 3, Concrete.
- 1.03 REFERENCE STANDARDS
 - A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36: Standard Specification for Carbon Structural Steel.
 - 2. ASTM A184: Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 3. ASTM A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 4. ASTM A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 5. ASTM A775: Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 6. ASTM A1064: Standard Specification for Carbon Steel Wire and Welded Wire reinforcement, Plain and Deformed, for Concrete.
 - B. American Concrete Institute (ACI):
 - 1. ACI 117: Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 315: Details and Detailing of Concrete Reinforcement.
 - 3. ACI 318: Building Code Requirements for Structural Concrete.
 - 4. ACI 350: Code Requirements for Environmental Engineering Concrete Structures.
 - C. Concrete Reinforcing Steel Institute (CRSI):
 - 1. CRSI: Manual of Standard Practice.
 - 2. CRSI: Placing Reinforcing Bars.
 - D. American Welding Society (AWS):
 - 1. D1.4: Structural Welding Code Reinforcing Steel.
 - E. Wire Reinforcement Institute (WRI):
 - 1. WWR-500-R: Manual of Standard Practice Structural Welded Wire Reinforcement.
- 1.04 SUBMITTALS
 - A. Submittals shall be made in accordance with all the requirements of the General Conditions and Division 1.

- B. Certificates: Submit the Manufacturer's certificate giving the properties of steel proposed for use. List the Manufacturer's test number and heat number, chemical analysis, yield point, tensile strength and percent elongation. Also identify on the certificates the proposed location of the steel in the work.
- C. Bill of Materials: Submit bills of materials to be reviewed with shop drawings.
- D. Shop Drawings:
 - 1. Show reinforcement fabrication, bar placement location, splices, spacing and bar designation, bar type, length, size, bending, number of bars, bar support type, and other pertinent information, including dimensions. Information must correspond directly to data listed on the bill of materials.
 - 2. Provide sufficient detail to permit placement of reinforcement without use of design drawings. Reproduction of design drawings for use as shop drawings is not permitted. Do not begin fabrication of reinforcing steel until after shop drawings have been reviewed by the Owner's Representative.
 - 3. Detail shop drawings in accordance with ACI 315.
 - 4. Rebar submittal shall include following information.
 - a. Grade of bars.
 - b. Table of bending dimensions, bar size, bar length, number of bars and spacing.
 - c. The reinforcing shall be listed separately for each structural element (wall, slab, footing, beam, etc.). Each element shall be labeled on the bar list and clearly identified on the shop drawings.
 - d. Each bar shall be identified such as corner bars, tie bars, vertical bars, etc.
- E. Quality Control Submittals.
 - 1. Mechanical Threaded Connections.
 - a. Provide verification that device threads have been checked and meet all requirements for thread quality, in accordance with manufacturer's published methods.
 - 2. Mill Test Reports.
 - a. Provide certified copies, evidencing compliance with the requirements of these Specifications, shall be delivered to the Owner with all deliveries of reinforcing steel.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Unloading, storing and handling bars on the job shall meet CRSI publication "Placing Reinforcing Bars", and the following:
 - 1. Deliver steel with suitable hauling and handling equipment.
 - 2. Tag steel for easy identification.
 - 3. Store to prevent contact with the ground.
 - 4. Protect reinforcing, as far as practicable, from mechanical injury, surface deterioration and rusting caused by exposure to the weather.

1.06 NOTIFICATION

- A. Notify the Owner's Representative at least 48 hours before concrete placement so that reinforcement may be inspected and errors corrected without delaying the work.
- PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Deformed Bars: Use Grade 60 deformed bars conforming to ASTM A615 unless indicated otherwise in the drawings.
- B. Welded Wire Fabric:
 - 1. Welded Deformed Wire Fabric. Conform to ASTM A1064 unless indicated otherwise in the drawings.
 - 2. Provide wire size, spacing and type as shown.
- C. Marking: Clearly mark all bars and welded wire fabric with waterproof tags showing the number of bars, size, mark, length and yield strength. Mark steel with the same designation as the member in which it occurs. Key marks to the concrete placement number as designated on the concrete place sequence shop drawings.

2.02 MECHANICAL CONNECTIONS

- A. Reinforcing steel bars shall be spliced with a mechanical connection when called for in the drawings. Splices may also be made with a mechanical connection when permitted by the Engineer in writing.
- B. Mechanical Couplers
 - 1. The mechanical coupler shall meet building code requirements for development in tension or compression. The coupler may be one of two types:
 - a. Positive locking, taper threaded type coupler manufactured from high quality steel. The bar ends must be taper threaded using the manufacturer's requirements.
 - b. Mechanical butt splices utilizing lock-shear bolts and internal serrated grip rails within the coupling sleeve.
 - 2. The mechanical coupler shall develop both tension and compression to a minimum of 125 percent of the specified yield strength of the reinforcing bar.
 - 3. Acceptable Products and Manufacturers:
 - a. LENTON taper threaded couplers as manufactured by ERICO.
 - b. Bar Lock mechanical coupler system manufactured by Dayton Superior.
- C. Metal Sleeve
 - 1. Provide with cast filler metal, capable of developing in tension or compression a minimum of 100 percent of specified ultimate tensile strength of the bar and not less than 150 percent of the specified yield strength.
 - 2. Acceptable Products and Manufacturers:
 - a. CADWELD Full Tensile Strength Splices, as manufactured by ERICO.

2.03 TIE WIRE

- A. Provide 16-gauge, black, soft-annealed wire where tie wire is not closer than 1 inch from surface of form after tying in place.
- B. Provide nylon-, epoxy-, or plastic-coated tie wire to fasten non-coated reinforcing steel, unless tie wire is bent to maintain a minimum of 1 inch from surface of form.
- C. Provide coated tire wire to fasten epoxy coated reinforcing steel.

2.04 BAR SUPPORTS

A. Provide chairs, riser bars, ties and other accessories made of metal, except as otherwise specified. Bar supports and accessories shall be of the sizes required to provide concrete cover as specified. Metal bar supports and accessories shall be Class 1 or 2 conforming to the requirements of CRSI Manual of Standard Practice.

2.05 FABRICATION

- A. Bending: Shop fabricate bars to the shapes shown on the drawings by cold bending. Bends shall conform to the minimum bend diameters specified in ACI 318. Do not heat, straighten or rebend bars without specific written approval from the Engineer. Field bending of bars is not permitted.
- B. Splices: Locate splices as shown on the drawings. Where it is necessary to splice reinforcement at locations other than shown on the drawings, the splices shall be approved by the Engineer. Use a minimum number of splices located at the points of minimum stress. Stagger splices in adjacent bars. Length of lap splices shall be in accordance with ACI 315, unless called out in the Drawings. When there is a conflict between ACI 315 and the Drawings, the more restrictive provision shall apply.
- C. Fabrication Tolerances:
 - 1. Bars must conform to the fabrication tolerances listed in all reference specifications. When there is a conflict in the reference specifications the more restrictive requirement shall apply.
- PART 3 EXECUTION
- 3.01 GENERAL
 - A. Meet all requirements of the CRSI and WRI documents referenced in this Section.
- 3.02 CLEANING
 - A. Clean reinforcement of all scale, loose or flaky rust or other foreign material, including oil, mud or coating that will reduce the bond to concrete.
- 3.03 PLACING REINFORCING BARS
 - A. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to properly assemble, space and support reinforcing. Wire ties through forms and temporary spacers will not be allowed. Provide accessories of sufficient number, size and strength to adequately prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each

intersection and to accessories. Blocking reinforcement with concrete or masonry is prohibited.

- B. Placement for Concrete on Ground: Support reinforcement on precast concrete blocks spaced at approximately 3 feet on centers each way. Use a minimum of one block for each 9 square feet. Tie blocks to at least one reinforcing bar using tie wires embedded in the block.
- C. Placement Tolerances: Meet the placement tolerances listed in all reference specifications. When there is a conflict in the reference specifications the more restrictive requirement shall apply.
- D. Interferences: If reinforcing interferes with the location of other reinforcing steel, conduits or embedded items, bars may be moved within specified tolerances or one bar diameter whichever is greater. If greater movement of bars is required to avoid interference, notify the Owner's Representative. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without approval of the Owner's Representative.
- E. Protection, Spacing and Positioning:
 - 1. Conform to reviewed shop drawings, Project Drawings, and all applicable reference specifications. When there is a conflict in the reference specifications the more restrictive requirement shall apply.
 - 2. Bundle or space bars as approved on shop drawings, instead of bending where construction access through reinforcing is necessary.
- F. Splices:
 - 1. Do not splice bars, except at locations shown on the Drawings or the reviewed shop drawings, without approval of the Engineer.
 - 2. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
 - 3. Stagger splices in adjacent bars.
- G. Construction Joints.
 - 1. Place reinforcing continuous through construction joints.
- H. Reinforcement Around Openings:
 - 1. Place an equivalent area of steel around pipe or opening and extend on each side sufficiently to develop bond in each bar unless otherwise noted in the Drawings.
 - 2. Refer to Details on Drawings for bar extension length of each side of opening.
 - 3. Where welded wire fabric is used, provide extra reinforcing using fabric or deformed bars.
- 3.04 PLACING WELDED WIRE FABRIC
 - A. Install wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus 2 inches, or 6 inches, whichever is larger. Do not make end laps midway

between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

- B. Tie laps and splices securely at ends and at least every 24 inches with 16-gauge black annealed steel wire.
- C. Place welded wire fabric on concrete blocks at proper distance above bottom of slab and rigidly support equal to that furnished for typical deformed bar reinforced steel.
- D. Do not use fabric that has been rolled. Install flat sheets only.
- 3.05 FIELD BENDING
 - A. Field bending of reinforcing steel bars is not permitted.
- 3.06 FIELD CUTTING
 - A. Reinforcing bars cut on the job shall be cut by shearing or sawing. Do not cut bars with a cutting torch.
- 3.07 MECHANICAL SPLICES AND CONNECTIONS
 - A. Use only in areas shown in the Drawings or specifically approved in writing by the Engineer.
 - B. Install as required by Manufacturer.
 - C. Carefully inspect each splice and verify that each component meets Manufacturer's requirements.
 - D. Maintain minimum edge distance and concrete cover.

CONCRETE JOINTS AND EMBEDDED ITEMS

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. This section specifies requirements for all concrete joints and embedded items for all cast-in-place concrete.
- 1.02 RELATED WORK
 - A. Division 3 Concrete
 - B. Division 5 Metals
 - C. Division 11 Equipment
 - D. Division 15 Mechanical
 - E. Coordinate work of this section with all other sections to obtain a proper installation. Review all drawings and specifications for additional requirements for joints and embedded items.
- 1.03 REFERENCE STANDARDS
 - A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM C881 Standard Specifications for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 3. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1059 Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
 - 5. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - 6. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 7. ASTM D994 Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - 8. ASTM D1751 Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 9. ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 10. ASTM D2240 Standard Test Method for Rubber Property Durometer Hardness.

- 11. ASTM D2628 Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- 12. ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- B. American Concrete Institute (ACI)
 - 1. ACI 301 Specifications for Structural Concrete.
 - 2. ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.
- C. U.S. Army Corps of Engineers (CRD)
 - 1. CRD-C572 Corps of Engineers Specifications for Polyvinyl Chloride Waterstops.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions and Division 1 General Requirements.
- B. Shop Drawings. Submit shop drawings showing all concrete joints, proposed sequences for concrete placement and type of concrete specified.
- C. Product Data.
 - 1. Submit manufacturer's technical literature on all products proposed for review. The submittal shall include the manufacturer's installation and/or application instruction.
 - 2. When substitutions are proposed for acceptable brands of materials specified herein, submit brochures and samples of proposed substitutions to the Engineer for approval before delivery to the project.
- 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING
 - A. All materials used for joints in concrete shall be stored and covered to prevent contact with the ground and to avoid contact with weather and direct sunlight. Follow all additional requirements of the manufacturer.
- PART 2 PRODUCTS
- 2.01 CONCRETE EXPANSION JOINTS (GENERAL)
 - A. Expansion Joint Sealant
 - 1. Single or multi-component cold-applied polyurethane elastomeric joint sealant conforming to ASTM C920. Sealant must be appropriate for the specific application. Provide joint primer according to Manufacturer's recommendation.
 - 2. Material Properties:
 - a. Ultimate hardness (ASTM D2240, Type A, Shore): 20 to 45.
 - b. Tensile strength (ASTM D412): 200 psi minimum.
 - c. Ultimate elongation (ASTM D412): 400% minimum.
 - d. Tear strength (ASTM D624, die C): 75 psi per inch of thickness, minimum.
 - e. Color: gray.

- B. Expansion Joint Filler
 - 1. Resilient non-bituminous material conforming to ASTM D1752. Material must be compatible with the joint sealant.
- C. Joint Accessories
 - 1. Backer Rod
 - a. Extruded closed-cell polyethylene foam rod compatible with the joint sealant. Rod shall be 25% larger than the joint opening.
 - 2. Bond Breaker Tape
 - a. Polyethylene or TFE-fluorocarbon self adhesive tape, compatible with the joint sealant.

2.02 CONCRETE EXPANSION JOINTS (EXTERIOR ROADWAY & PAVEMENTS ONLY)

- A. Expansion Joint Sealant
 - 1. Hot-poured elastic joint sealant conforming to ASTM D6690. Sealant must be appropriate for concrete pavement. Provide joint primer according to Manufacturer's recommendation.
- B. Expansion Joint Filler
 - 1. Preformed bituminous type conforming to ASTM D994. Material must be compatible with the joint sealant.
- 2.03 CONCRETE BONDING AGENT
 - A. Concrete Exposed to Water and/or Chemicals
 - 1. ASTM C881, Type IV. Grade and Class shall be as required for the project application. A field service representative of the Manufacturer shall be available during initial application to instruct the Contractor in the proper use of the product when so requested by the Engineer or the Owner.
 - B. Concrete Not Exposed to Water or Chemicals
 - 1. Acrylic bonding agent conforming to ASTM C1059.
- 2.04 BOND BREAKER
 - A. 30-pound asphalt saturated felt or polyethylene membrane.
- 2.05 EXPANSION JOINT DOWELS
 - A. Smooth steel bars shall conform to the requirements of Section 03200. Cut dowels to length at shop or mill before delivery to the site. Dowels must be straight and clean, free of loose flaky rust and loose scale.
- 2.06 EXPANSION JOINT DOWEL SLEEVES
 - A. Standard weight galvanized pipe conforming to ASTM A53.
2.07 WATERSTOPS

- A. General: All waterstop materials shall be compatible with potable water applications per AWWA and any other industry standards.
- B. Polyvinyl Chloride Waterstops
 - 1. Material Requirements
 - a. Waterstops shall be extruded from virgin polyvinyl chloride compound and shall conform to the requirements of the Corps of Engineers Specification CRD-C572. Waterstops shall be uniform in dimension, homogenous and free from porosity. No reclaimed or scrap material may be used.
 - b. Tensile strength: 1400 psi minimum
 - c. Ultimate Elongation: 280 percent minimum
 - 2. Construction Joints
 - a. Ribbed type without center bulb
 - b. 6 inch minimum width
 - c. 3/8 inch minimum thickness
 - 3. Expansion Joints
 - a. Dumbbell type with a minimum 3/4-inch inside diameter center bulb.
 - b. 9 inch minimum width
 - c. 3/8 inch minimum thickness
- C. Hydrophilic Waterstops
 - 1. Hydrophilic waterstop materials shall be bentonite-free and expand by a minimum of 80% of dry volume in the presence of water to form a water-tight joint without damaging the concrete in which it is cast.
 - 2. The material shall absorb water and cause an increase in volume in a completely reversible and repeatable process. The material shall be dimensionally stable after repeated wet-dry cycles with no deterioration in swelling potential.
 - 3. Minimum cross sectional dimensions are 3/16 inch by 3/4 inch.
 - 4. Provide only where specifically indicated in the Project Documents.
- D. Hydrophilic Sealants
 - 1. Hydrophilic sealant shall be compatible with hydrophilic waterstop and shall firmly adhere to concrete, metal and PVC in a dry or damp condition. When cured, it shall be elastic indefinitely.
- E. Hydrophilic Injection Resin
 - Hydrophilic injection resin shall be acrylate-ester based with a viscosity of less than 50 cps. The resin shall be water soluble in its uncured state, solvent free and nonwater reactive. In its cured state it shall form a solid hydrophilic flexible material resistant to permanent water pressure and compatible with bitumen, joint sealants and concrete.
- 2.08 EPOXY ANCHORS
 - A. Refer to Section 05051.

- B. If Section 05051 is not in the Project Documents, provide the following:
 - 1. Provide stainless steel adhesive anchors and hardware complying with ASTM F593, AISI Type 316 headed with stainless steel nuts and washers.
 - 2. Adhesive system shall Hilti HIT-HY200 adhesive, by Hilti. No substitutions will be considered.
 - 3. Embedment depth of the anchor shall provide pullout strength equal to the allowable tensile capacity of the anchor, unless otherwise noted in the Drawings. Reduction in pullout strength due to spacing and edge distances shall be made.

2.09 MISCELLANEOUS EMBEDDED METAL ITEMS

- A. Miscellaneous embedded metal items shall conform to the requirements Section 05051 or the section of the specifications to which they apply. In the case of conflicting requirements, the most restrictive requirements shall apply.
- B. Use "Form Saver" or "Threaded Coupler" to avoid drilling holes in the forms.
- C. Paint aluminum contact surfaces with a zinc rich primer where aluminum items are embedded in concrete.
- PART 3 EXECUTION
- 3.01 CONSTRUCTION JOINTS
 - A. General
 - Make construction joints only at locations shown and required on the Contract Drawings, the reviewed shop drawings or as directed or approved by the Engineer. Any additional construction joints or relocation of construction joints shown on the drawings that are proposed by the Contractor must be submitted to the Engineer for review.
 - 2. In addition to construction joints explicitly shown in the Drawings, provide and locate additional construction joints as follows:
 - a. In walls locate vertical construction joints at a maximum spacing of 40 feet.
 - b. In foundation slabs and slabs-on-grade locate construction joints at a spacing of 50 feet maximum. Place concrete in a strip pattern, unless otherwise indicated in the Contract Drawings, to a maximum of 2500 square feet in any one placement.
 - c. In structural slabs and beams locate construction joints at a maximum spacing of 50 feet. Locate construction joints in compliance with ACI 301, unless otherwise indicated in the drawings, to a maximum of 2500 square feet in any one placement.
 - 3. Allow a minimum of three (3) days to elapse before placing concrete adjacent to a slab or wall previously placed.
 - 4. All joints shall be perpendicular to main reinforcement; continue all reinforcing across the joint.
 - 5. Provide waterstops in all wall and slab construction joints as specified or in all water bearing structures, all below grade joints and at locations shown on the Drawings.
 - B. Construction Joint Preparation

- 1. The joint surface of the previously cast member or existing concrete in all cases shall be cleaned free of all oil, grease, curing compound, dirt, or laitance, and shall be wetted. Cleaning shall be accomplished by high pressure water jet, wet sand blasting, dry sand blasting, or scrubbing, singly or in combination, as required and shall remove loosened particles of aggregate, damaged concrete at surface, and other substances which may prevent complete adhesion. Remove accumulated concrete on projecting reinforcing steel.
- 2. Construction joints shall be roughened mechanically to a full amplitude of ¼ inch. Thoroughly clean joint surfaces as described in this Section. Coat joints with neat cement slurry with the consistency of a heavy paste and scrub into surfaces by means of a stiff bristled brush. Place new concrete before cement paste dries. As an alternative to using a neat cement slurry, a bonding agent may be utilized.

3.02 EXPANSION JOINTS

- A. Do not extend reinforcement or other embedded metal items that are continuously bonded to concrete through any expansion joints.
- B. Position dowels accurately if called for in the Drawings. Support dowels against displacement during concrete placement and vibration. Install dowel sleeve grout-tight to prevent bonding of the dowel during concrete placement.
- C. Position expansion joint filler material accurately. Support against displacement during concrete placement and vibration. Place filler the full depth of the member less an allowance to form a groove for sealant as detailed.

3.03 CONTROL JOINTS

- A. Control joints shall be provided in non-water bearing slabs-on-grade only as shown in the Drawings and specified herein.
- B. Make top grooves for control joints in slabs on grade as detailed and seal as specified. Grooves may be made with joint forming strip, via tooling or may be sawed.
- C. If control joints are sawed, properly time cutting with concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking and within twelve (12) hours of concrete placement. The Contractor shall have at least one spare saw available during the sawing operation.
- D. Control joints shall be cleaned and filled with expansion joint sealant. Inject sealant through a nozzle into the bottom of the joint, filling the entire joint space without air voids.

3.04 WATERSTOPS

- A. General
 - 1. Provide PVC waterstops in all horizontal and vertical joints in foundation slabs and peripheral walls of all structures up to a minimum of 12 inches above final ground level and all walls and slabs of liquid-containing structures or compartments to a minimum of 12 inches above maximum liquid level unless specifically shown otherwise on the Drawings.

- B. PVC Waterstops
 - 1. Each piece of premolded PVC waterstop must be of maximum practicable length for a minimal number of end joints.
 - 2. All PVC waterstops shall be continuous, and so jointed as to form a complete barrier to the passage of water through any construction, control/contraction or expansion joint.
 - 3. Joints in PVC waterstops shall be made by heat sealing in accordance with the requirements of the Manufacturer. The joints in strips of waterstop shall be such that the entire cross section of the joint shall be dense, homogeneous and free of all porosity. All finished joints shall have a tensile strength of not less than 75% of the material of the strip as extruded.
 - 4. All PVC waterstops shall be installed so that half its width will be embedded on each side of the joint. Tie the waterstop to the reinforcement at a maximum spacing of 18 inches to ensure that the waterstop will be held securely in true position and in straight alignment in the joint during placement and vibration of concrete.
 - 5. Care shall be exercised to ensure that the PVC waterstop is completely embedded in concrete and without voids.
- C. Hydrophilic Waterstops
 - 1. Install all hydrophilic waterstops as called for in the Contract Drawings in accordance with the Manufacturer's requirements. Install hydrophilic sealant in accordance with all Manufacturer's requirements.
 - 2. The hydrophilic waterstop shall be installed in a bed of hydrophilic sealant compatible with the hydrophilic waterstop before skinning and curing begins so that any irregularities in the concrete surface are completely filled and the waterstop is bonded to the sealant. After the sealant has cured, secure the waterstop to the concrete in accordance with the Manufacturer's instructions.
 - 3. Prior to installation of the hydrophilic sealant, clean the concrete surface to removed laitance and any other materials that will adversely affect bonding of the sealant to the concrete.

3.05 SEALING JOINTS

- A. Clean, prime and apply sealants in accordance with Manufacturer's recommendations.
- B. Sealant shall be applied when the ambient temperature is between 40° F and 90° F, unless recommended otherwise by the sealant Manufacturer.
- C. During application, exercise care to prevent sealant from spilling onto surfaces adjacent to joints.
- 3.06 DOWELS
 - A. Where indicated on Drawings, install dowels at right angles to construction joints and expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement.

3.07 SETTING ANCHORS

- A. Anchor embedded reinforcing, bolts and other items as shown on the Drawings into existing concrete with an epoxy in accordance with these Specifications and all Manufacturer's recommendations.
- 3.08 SETTING ANCHOR BOLTS
 - A. Set anchor bolts for structural steel specified in Division 5 Metals, according to this Section.
 - B. Install equipment anchor bolts as required by the equipment Manufacturer.
 - C. Provide accurately made templates for positioning anchor bolts.

3.09 EMBEDDED ITEMS

- A. Placement
 - Place embedded items to least impair strength of the structure. Obtain approval of locations for embedded items not shown on the Drawings before placement of concrete. Should locations of embedded items be detrimental to the strength of the structure, notify the Owner's Representative and relocate items as directed by the Owner.
 - 2. Do not cut or reposition reinforcing steel to facilitate installation of inserts, conduit, sleeves, anchor bolts, mechanical openings and similar items without prior approval of the Engineer, except that reinforcing bars may be moved one bar diameter or within tolerances specified in the Concrete Reinforcement section without approval of the Engineer as long as minimum specified reinforcing cover requirements are maintained.
 - 3. It is the Contractor's responsibility to coordinate the requirements for embedded items and to ensure that embedded items are properly placed.

B. Installation

- 1. Accurately position and support embedded items against displacement during concrete placement.
- 2. Voids in sleeves, inserts, anchors, etc., shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.
- 3. Conduits, pipes and inserts of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- 4. Except when plans for conduits and pipes are approved by the Engineer, conduits and pipes embedded within a slab, wall or beam shall satisfy the following:
 - a. They shall not be larger in outside dimension than 1/3 the overall thickness of slab, wall or beam in which they are embedded.
 - b. They shall not be spaced closer than three diameters or widths on center.
 - c. They shall not significantly impair the strength of the member.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. This section contains all requirements for cast-in-place structural concrete.
- 1.02 RELATED WORK
 - A. Coordinate the requirements of this section with all other sections of Division 3, Concrete.
- 1.03 REFERENCE STANDARDS
 - A. American Society for Testing and Materials (ASTM).
 - 1. ASTM C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C33: Standard Specification for Concrete Aggregates
 - 3. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 4. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - 5. ASTM C87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
 - 6. ASTM C94: Standard Specification of Ready-Mixed Concrete
 - 7. ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
 - 8. ASTM C125: Terminology Relating to Concrete and Concrete Aggregates
 - 9. ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete
 - 10. ASTM C150: Standard Specification for Portland Cement
 - 11. ASTM C156: Standard Test Method for Water Retention Through Liquid Membrane-Forming-Curing Compounds for Concrete
 - 12. ASTM C171: Standard Specification for Sheet Materials for Curing Concrete
 - 13. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete
 - 14. ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 15. ASTM C191: Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
 - 16. ASTM C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

- 17. ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- 18. ASTM C260: Standard Specification for Air-Entraining Admixtures for Concrete
- 19. ASTM C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
- 20. ASTM C293: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
- 21. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- 22. ASTM C494: Standard Specification for Chemical Admixtures for Concrete
- 23. ASTM C579: Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
- 24. ASTM C580: Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
- 25. ASTM C595: Standard Specification for Blended Hydraulic Cements
- 26. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- 27. ASTM C806: Standard Test Method for Restrained Expansion of Expansive Cement Mortar
- 28. ASTM C827: Standard Test Method for Change in Height at Early Stages of Cylindrical Specimens of Cementitious Mixtures
- 29. ASTM C845: Standard Specification for Expansive Hydraulic Cement
- 30. ASTM C856: Standard Practice for Petrographic Examination of Hardened Concrete
- 31. ASTM C878: Standard Test Method for Restrained Expansion of Shrinkage-Compensating Concrete
- 32. ASTM C1077: Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
- 33. ASTM C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
- 34. ASTM C1240: Standard Specification for Silica Fume used in Cementitious Mixtures
- 35. ASTM E329: Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
- B. American Concrete Institute (ACI).
 - 1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavy-weight and Mass Concrete.
 - 2. ACI 214: Guide to Strength Test Results of Concrete
 - 3. ACI 223: Guide for the Use of Shrinkage Compensating Concrete

- 4. ACI 301: Specification for Structural Concrete
- 5. ACI 302.1: Guide for Concrete Floor and Slab Construction
- 6. ACI 304: Guide for Measuring, Mixing, Transporting & Placing Concrete
- 7. ACI 304.2R: Placing Concrete by Pumping Methods
- 8. ACI 305R: Guide to Hot Weather Concreting
- 9. ACI 306R: Guide to Cold Weather Concreting
- 10. ACI 308: Guide to Curing Concrete
- 11. ACI 308.1: Specification for Curing Concrete
- 12. ACI 309: Guide for Consolidation of Concrete
- 13. ACI 318: Building Code Requirements for Structural Concrete.
- 14. ACI 350: Code Requirements for Environmental Engineering Concrete Structures

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with all the requirements of the General Conditions and Division 1.
- B. Submit for review a proposed design mix for each concrete strength and class required by these Specifications. Failure to include any items of information noted in this paragraph for a given concrete strength or type will be cause for requirement of a resubmittal. Information to be submitted for each strength and class shall include the following items:
 - 1. Concrete mix design
 - a. Constituent quantities per cubic yard.
 - b. Sources of all concrete mix components including coarse aggregate, fine aggregate, cement, water, admixtures, and pozzolans where included.
 - c. Cement type and manufacturer, include chemical analysis (mill test report) for each cement type to be used.
 - d. Pozzolan type and source; include chemical analysis for each pozzolan type to be used.
 - e. Water/cement ratio, by weight.
 - f. Air content
 - g. Mix design slump.
 - h. Average compressive strengths conforming to the requirements of ACI 318 Chapter 5, Section 5.3.2 at 28 days. Provide both average strengths and sample standard deviation. Provide results at 7 and 14 days if available.
 - i. Laboratory shrinkage test results for concrete mix designs, where specified.
 - 2. Aggregate:
 - a. Current Laboratory sieve analysis, conforming to ASTM C-33.
 - b. Verification that aggregate is not "deleterious," or "potentially deleterious." Provide ASTM C289 test results if available. Otherwise provide documentation or other certification that aggregate does not contain deleterious substances and has been used without issues on previous projects.
 - 3. Admixtures. Submit Manufacturer's data brochures on all admixtures proposed for use and provide certification of compliance with specified ASTM standards for each admixture.

- C. Submit concrete placement drawings showing pour sequence, lift numbers, locations of all joints, concrete mix being placed, concrete finishes, and all pertinent embedments including embedded plates, sleeves, pipes, conduits, anchors, etc., where applicable. Where the Drawings permit the Contractor to select joint locations, show the selected dimensions on the placement drawings. Approval of the placement drawings shall not relieve the Contractor of the responsibility of placing all concrete and embedments as specified.
- D. If cold weather or hot weather concrete conditions are anticipated on the Project, submit a work plan for cold weather concreting and/or for hot weather concreting, describing proposed methods and procedures for mixing, delivering, placing, finishing, and curing concrete. Include also procedures to be implemented upon abrupt changes in weather conditions or due to equipment failures. If a plan for either is not submitted and cold or hot weather concrete conditions are present, the Contractor will not be allowed to pour concrete until a plan is received and reviewed as long as cold or hot weather conditions are present on the Project.
- E. Furnish a delivery ticket for ready mixed concrete to the Owner's Representative as each truck arrives. Each ticket shall provide a printed record of the weight of cement batched and each separate aggregate individually batched. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement, and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of mix trucks.
- F. Submit Manufacturer's data sheets and product specifications for curing compounds and items specified in other Sections including form release agents, bonding agents, etc. Identify the locations where each will be used in the Work as a part of the submittal.
- G. Submitted data shall demonstrate compliance with all requirements of this Specification or deviations shall be clearly noted.

1.05 STORAGE OF MATERIALS

- A. Cement: Store cement in watertight buildings, bins or silos to provide protection from dampness and contamination. Improperly stored cement shall not be used. No cement shall be used that has been stored on the site for more than 90 days or that is lumped or caked.
- B. Aggregate: Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregates.
- C. Sand: Before using, allow sand to drain until a uniform moisture content is reached.
- D. Admixtures: Store admixtures to avoid contamination, evaporation or damage. For those used in the form of suspensions or nonstable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work of similar scope and complexity with similar materials as found on this Project.
- B. Manufacturer's Qualifications: An experienced manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment. Manufacturer must be certified by the National Ready Mix Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An experienced independent testing agency, acceptable to authorities having jurisdiction and the Engineer that is qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from a single source and each admixture from the same manufacturer.
- E. Concrete Consistency
 - 1. Test for slump shall be performed at the job site immediately prior to placing in accordance with ASTM C143. Slump tests shall be performed for each batch of concrete to indicate workability and consistency from batch to batch.
 - 2. If the slump is greater than the specified maximum, the concrete shall be rejected. Concrete showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed.
 - 3. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, the concrete shall be rejected and changes in the concrete mix shall be made only by an adjustment of one or more of the following:
 - a. The gradation of aggregate.
 - b. The proportion of fine and coarse aggregate.
 - c. The percentage of entrained air, within the allowable limits.
- F. Concrete Temperature
 - 1. Concrete temperature shall be taken immediately before placement with the point of measurement being in the chute or bucket.
 - 2. Perform temperature test for each batch and record result on batch ticket.
- G. Concrete Air Content
 - 1. Test for air content shall be made on a fresh concrete sample for each batch prior to placing in forms.
 - 2. Air content for concrete made of ordinary aggregates having low absorption shall be made in accordance with either ASTM C231, or ASTM C173. If light weight aggregates or aggregates with high absorptions are used, use ASTM C173.
- H. Compressive Strength
 - 1. Compression test specimens shall be made, cured and tested in accordance with ASTM C31 and ASTM C39.

- 2. Compressive strength tests shall be made on cylinders at 7 and 28 days. The value of each test result shall be the average compressive strength of 2 cylinders taken at the same time from the same batch of concrete. For the 28 day cylinders, the strength level shall be satisfactory if the test result exceeds the required design compressive strength and no individual strength result falls below the required design strength by more than 500 psi.
- 3. Compressive test specimens shall be 6" x 12" cylinders; 4" x 8" cylinders are not permitted.
- 4. The number of sets of concrete test cylinders to be cast for each concrete pour shall be as follows. A "set" of test cylinders consists of six cylinders, two to be broken and strengths averaged at seven days; and two broken and strengths averaged at 28 days. Two hold cylinders will remain unbroken so that they will be available to be broken upon unforeseen circumstances or upon the option of the Engineer to break cylinders at different times.

Volume of Concrete Poured (CY)	Minimum No. of Sets of Cylinders
0-25	1
26-75	2
76-150	3
151-250	4
251-400	5
401-550	6

- I. Failure to Meet Requirements
 - The Owner may withhold payment for any section of concrete which does not meet the requirements of the Plans and Specifications. Withheld payment shall be based upon unit prices established for concrete if available. Payment shall be withheld until the unacceptable concrete has been repaired or removed and replaced or otherwise brought into conformance with the Plans and Specifications.
 - 2. Concrete Strength
 - a. If the 28 day strength test results fall below required values, additional curing may be performed and test cores may be obtained in accordance with ASTM C42 with approval of the Engineer. Additional curing, core removal and testing shall be at the Contractor's expense.
 - b. If the strength results from test cores do not exhibit the required strength, the Owner reserves the right to require strengthening, replacement of substandard materials and/or additional testing at the Contractor's expense.
 - 3. Other Concrete Properties
 - a. If concrete properties besides strength do not meet required values, the Engineer may require concrete samples to be obtained in accordance with ASTM C42 and evaluated in accordance with ASTM C856 at the Contractor's expense.
 - b. If concrete properties besides strength do not meet required values, and the results of additional examination per ASTM C856 are deemed unsatisfactory at the sole discretion of the Owner, the Owner reserves the right to require strengthening, replacement of substandard materials and/or additional testing at the Contractor's expense.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cementitious Materials
 - 1. Portland Cement:
 - a. Type II or Type I/II conforming to ASTM C 150. Use the same brand of cement upon which the selection of concrete was based. Only one brand of each type will be permitted in any one structure, unless otherwise specified.
 - Cement shall be low alkali; The total alkali content calculated as the percentage of sodium oxide (Na₂O) plus 0.658 times the percentage of potassium oxide (K₂O) shall not exceed 0.60.
 - c. Cement used in concrete placed in openings in existing water bearing structures shall be shrinkage compensating cement, ASTM C845.
 - 2. Fly Ash:
 - a. Fly ash, when used, shall meet the requirements of ASTM C618, Class F, except as follows:
 - (i) The loss on ignition shall not exceed 4.0%.
 - (ii) The maximum percent of sulfur trioxide (SO3) shall be 4.0%.
 - b. Fly ash shall be considered a cementitious material for concrete proportioning.
 - c. Fly ash content shall not exceed 30% by weight of the total cementitious content (Portland cement plus fly ash) of the concrete.
- B. Coarse Aggregate
 - 1. Crushed stone or gravel conforming to ASTM C33, in the specified gradation size. Use aggregate from only one source in a single structure. Aggregate shall not be "deleterious," or "potentially deleterious," per ASTM C289 and shall not contain deleterious substances.

Gradation No. 467 (max aggregate size 1 1/2")			
Sieve Size	Percent Retained	Percent Passing	
2"	0	100	
1 1/2"	0-5	95-100	
3/4"	30-65	35-70	
3/8"	70-90	10-30	
No. 4	95-100	0-5	

Gradation No. 57 (max aggregate size 1")			
Sieve Size	Percent Retained	Percent Passing	
1 1/2"	0	100	
1"	0-5	95-100	
1/2"	40-75	25-60	
No. 4	90-100	0-10	
No. 8	95-100	0-5	

Gradation No. 67 (max aggregate size 3/4")			
Sieve Size	Percent Retained	Percent Passing	
1"	0	100	
3/4"	0-10	90-100	
3/8"	45-80	20-55	
No. 4	90-100	0-10	
No. 8	95-100	0-5	

Gradation No. 8 (max aggregate size 3/8")			
Sieve Size	Percent Retained	Percent Passing	
1"	0	100	
3/8"	0-15	85-100	
No. 4	70-90	10-30	
No. 8	90-100	0-10	
No. 16	95-100	0-5	

C. Fine Aggregate

1. Washed and screened natural sand or sand manufactured by crushing stone conforming to ASTM C33 and meeting the following gradation. Use aggregate from only one source in a single structure. Aggregate shall not be "deleterious," or "potentially deleterious," per ASTM C289 and shall not contain deleterious substances

Sieve Size	Percent Retained	Percent Passing
3/8""	0	100
No. 4	0-5	95-100
No. 8	0-20	80-100
No. 16	15-50	50-85
No. 30	40-75	25-60
No. 50	70-90	10-30
No. 100	90-98	2-10

- D. Mixing Water: Potable and complying with ASTM C94
- E. Admixtures: Using the following admixtures as required or permitted. The use of calcium chloride will not be permitted. The products must conform to the referenced standards.
 - 1. Air-Entraining Admixture. Conform to ASTM C260.

- 2. Chemical Admixtures. Conform to ASTM C494.
- 3. Set retarding Admixtures. Conform to ASTM C494, types B or D only. Follow all Manufacturer's recommendations.
- 4. Water Reducing Admixture. Conform to ASTM C494, types A or D only. Follow all Manufacturer's recommendations.
- 5. High-Range Water Reducing Admixtures (HRWR). Conform to ASTM C 494 Type F or G. Follow all manufacturer's recommendations.

2.02 CHEMICAL HARDENER

- A. Provide a clear chemical hardener as called for in the Drawings. Coordinate concrete mix design, air content requirements and placement procedures with the chemical hardener manufacturer.
- B. Provide one of the following products:
 - 1. MASTERTOP 110 ABR/Maximent® HD; by BASF.
 - 2. Diamond-Plate; by Euclid.

2.03 CURING MATERIALS:

- A. Membrane Curing Compound.
 - 1. Conform to ASTM C309, commercial curing compound which will not permanently discolor concrete.
 - 2. All curing compound shall contain a dye of color strength to render the film distinctly visible on the concrete for at least 4 hours after application.
- B. Sheet Curing Material.
 - 1. Conform to ASTM C 171.
 - a. Waterproof paper
 - b. Polyethylene film
 - c. White burlap-polyethylene sheeting

2.04 CONCRETE PROPORTIONING

- A. Design Criteria
 - Use ACI 211.1 as the basis for selecting the proportions of ingredients to produce concrete having proper durability, strength, workability appearance and other required properties. Proportion ingredients to produce a homogenous mixture, which will work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on the work, but without permitting materials to segregate or allowing excessive free water to collect on the surface.
 - 2. Strength: All concrete is required to have an average 28 day compressive strength at or greater than specified strength. Establish the required average compressive strength in accordance with ACI 301.
 - 3. Entrained Air: Air-entrain all concrete, unless otherwise specified. Drilled shafts do not require air entrainment unless placed underwater. Provide for not less than

three percent (3.0%) nor more than six percent (6.0%) by volume of total entrapped and entrained air for normal weight concrete.

- 4. Slump: Provide adequate slump to produce acceptable workability, do not exceed maximum specified slump.
- 5. Admixtures: Proportion admixtures according to the Manufacturer's recommendations. All admixtures shall be batched at the batch plant only.
- B. Concrete Classification

Class	Min. 28-Day Compressive Strength (psi)	Max. Coarse Aggregate Size (in.)	Max. Water Cement Ratio	Max. Slump (in.)	Min. Cement Content (per CY)
А	4000	1.5 (No. 467)	0.45	5	517 lb. (5.5 sacks)
В	3000	1.5 (No. 467)	0.50	4	517 lb. (5.5 sacks)
С	4000	1.0 (No. 57)	0.45	4	564 lb. (6.0 sacks)
D	5000	0.75 (No. 67)	0.45	5	611 lb. (6.5 sacks)
Е	1500	1.5 (No. 467)	0.70	4	376 lb. (4.0 sacks)
F	4000	0.375 (No. 8)	0.50	8	611 lb. (6.5 sacks)

NOTE: Maximum slump shown may be increased to 9 in. if HRWR admixture is used.

C. Concrete Usage

Class	Usage
A	All reinforced concrete unless otherwise specified
В	Concrete Encasement; Sidewalks, Curbs, Driveways
С	Drilled Shafts; Pumped Concrete; Thin Wall Sections
D	Precast Concrete and Panels
E	Lean Concrete Backfill: Foundation Seal: Blocking/Cradling
F	Underground Duct Banks

- 2.05 OFF SITE BATCH PLANT
 - A. Batch plants shall be an established concrete batching facility meeting the requirements of the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau.
- 2.06 CONCRETE MIXING
 - A. Ready-Mixed Concrete:

- 1. Mix and transport ready-mixed concrete according to ASTM C94.
- 2. Provide a suitable measuring device capable of measuring mixing water for each batch. Note the number of gallons of water as batched on printed batching tickets.
- 3. Compensate for varying moisture contents of both coarse and fine aggregates and change batch weights of materials if necessary before batching.
- 4. Provide adequate facilities for accurate measurement and control of each material entering each batch of concrete. Accuracy of weighing equipment must conform to applicable requirements of ASTM and NRMCA for such equipment.
- 5. Provide recorders/printers to produce tickets. Each ticket will provide a printed record of volume of water and weights for cement as batched and for separate aggregates as batched individually. Use the type of indicator that returns for zero punch or to zero after a batch is discharged. Clearly indicate by stamped letters or numerals the difference between aggregates and cement as batched. Show the time of day stamped or printed at intervals of not more than six minutes. The delivery ticket shall also show the volume of water, in gallons, added at the batch plant. Deliver recorded ticket copies with concrete. The testing agency will keep one copy.
- B. Transit Mix Truck Requirements:
 - 1. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant.
 - 2. Keep the water tank valve on each transit truck locked at all times that the truck is in use. Any addition of water must be directed by the Engineer. Added water must be incorporated by additional mixing of at least 35 revolutions.
 - 3. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds. Counter shall be reset to zero at the batch plant. Concrete may be rejected if counters have fewer than 70 or more than 150 turns when they arrive at the site.
 - 4. Transmit mix trucks are to be in good working condition. Trucks which are not mechanically sound, have worn or obstructed mixing fins, have non-functioning drum counters, or leaking water valves shall not be used.
- C. Admixtures:
 - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device. Do not use admixtures in powdered form.
 - 2. Two or more admixtures may be used in the same concrete, provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other. Inject the admixtures separately during the batching sequence.
 - 3. Add retarding admixtures as soon as practicable after the addition of cement.

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify the Owner's Representative upon completion of various portions of the work required for placing concrete so inspection may be made as early as possible. Keep the Owner's Representative informed of the anticipated concrete placing schedules.
- B. All items, including lines and grades, forms, waterstops, reinforcing, inserts, piping, electrical, plumbing and the Contractor's concreting materials and equipment shall be complete and in compliance with the plans and specifications before proceeding with concrete placement.
- C. Concrete finishing shall be completed in daylight hours. When this is not possible, brilliantly light the work site so that all operations are plainly visible.
- D. Prior to and during concrete placement, forms shall be clean of any and all foreign matter.
- E. Mix concrete only in quantities for immediate use. Discard concrete which has set; retempering is not permitted. Completely discharge concrete at the site within one hour and 30 minutes after adding cement to aggregate. In hot weather, reduce this time to one hour or less to prevent stiffening of concrete before it is placed.
- F. Protection from Adverse Weather: If adverse weather is imminent, no concrete placement is permitted. Do not permit rainwater to increase mixing water or to damage the surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect the work.
- G. If concrete arrives at the project with slump below that specified, water may be added only if the addition of water does not exceed either the maximum permissible watercement ratio or maximum slump. Mix adjustments to obtain specified slump must be approved by the Engineer.
- H. Cold Weather Concreting
 - 1. If the air temperature is at or below 40 degrees F, cold weather concreting shall be performed in accordance with ACI 306. This includes cases where the temperature drops below 40 degrees F after concrete operations have been started. The temperature shall be taken in shade away from artificial heat.
 - 2. When air temperatures are at or below 40 degrees F, heated mixing water or a combination of heated mixing water and heated aggregates shall be used, if required, to raise the concrete temperature to 70 degrees F. The temperature of the heated water or aggregates shall not exceed 150 degrees F when entering the mixer.
 - 3. Concrete placement is not permitted when the air temperature is at or below 35 degrees F. The temperature shall be taken in shade away from artificial heat.
 - 4. Salts, chlorides, chemicals or other foreign materials shall not be mixed with the concrete to prevent freezing or act as an accelerator.
 - 5. When freezing temperatures may be expected during the curing period, the concrete shall be maintained at a temperature of at least 50 degrees F for five days or 70 degrees F for three days after placement. Concrete and adjacent form surfaces shall be kept continuously moist. Sudden cooling of concrete shall not be permitted.

- I. Hot Weather Concreting.
 - 1. Hot weather concreting shall comply with ACI 305. At air temperature of 90 degrees F or above, concrete shall be kept as cool as possible during placement and curing.
 - 2. The temperature of the concrete when placed in the work shall not exceed 90 degrees F. Use chilled water or ice to reduce the temperature of the concrete as required.
 - 3. Concrete shall be placed in the forms without the addition of any more water than is required by design. No excess water may be added to the concrete surface to aid in finishing. Control of the initial set and extending the time for finishing may be accomplished through the use of admixtures in accordance with these Specifications.
 - 4. Plastic shrinkage cracking, due to rapid evaporation of moisture, shall be prevented. Concrete shall not be placed when the evaporation rate (actual or anticipated) equals or exceeds 0.2 pound per square foot per hour, as determined by Figure 2.1.5 in ACI 305.

3.02 EMBEDDED ITEMS

- A. Refer to Section 03250.
- 3.03 JOINTS
 - A. Construction, control, isolation and expansion joints shall be installed and sealed as called for by the Plans and in accordance with Section 03250.
- 3.04 WATERSTOPS
 - A. PVC and hydrophilic waterstops shall be installed as called for by the Plans and in accordance with Section 03250.
- 3.05 GROUTING
 - A. Perform all grouting as called for by the Plans and in accordance with Section 03600.
- 3.06 CONCRETE TRANSPORTATION AND CONVEYING
 - A. Delivery tickets shall be required for each batch and shall be in accordance with ASTM C94, Section 16. Each ticket must clearly show the amount of water, in gallons, that can be added to the mixer truck at the site without exceeding the maximum water-cement ratio for that mix design.
 - B. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Use methods which prevent loss of ingredients and segregation.
 - 1. Troughs, chutes and pipes shall be steel or steel lined.
 - 2. When steep slopes are necessary, provide baffles.
 - 3. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete.
 - 4. Concrete pumping is permitted and shall comply with ACI 304.2R.

3.07 CONCRETE PLACEMENT

A. Preparation

- 1. Sprinkle semi-porous subgrades to eliminate suction.
- 2. Seal extremely porous subgrades in an approved manner.
- 3. Clean and prepare existing concrete surface in accordance with these Specifications prior to placing new concrete.

B. General

- 1. Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of cold joints, seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
- 2. Proceed with placement at a rate such that concrete which is being integrated with fresh concrete is still plastic. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
- 3. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only if made of galvanized metal or concrete, and if prior approval has been obtained.
- 4. Do not start placing of concrete in supported elements until concrete previously placed in columns and walls is no longer plastic.
- 5. Deposit concrete as nearly as practicable in its final position to avoid segregation. Do not subject concrete to a procedure which will cause segregation.
- 6. Deposit concrete through vertical drop chutes of rubber or metal of satisfactory size when operations involve placing concrete from above.
- 7. Concrete shall not be dropped more than 10 feet when HRWR admixture is used and 5 feet without HRWR.
- 8. Where surface mortar is to be the basis of a finish, especially those designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of mortar against the form. Prevent formation of excessive surface voids.

C. Slabs

- 1. After suitable bulkheads, screeds and if specified, jointing materials, have been positioned the concrete shall be placed continuously between construction joints, beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
- 2. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints.
- Concrete shall then be brought to correct level with a straightedge and struck off. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.

- D. Formed Concrete
 - 1. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall be in contact with the concrete already placed.
 - 2. In walls, place concrete in 12" to 24" lifts, keeping the surface horizontal. Compaction shall be by vibrator and shall be supplemented by hand puddling; puddling shall be continuous while pouring concrete and shall be done primarily between forms and reinforcing steel, around openings, or wherever needed to prevent honeycomb, fill voids or drive out large air bubbles.
- E. Concrete Poured Against Rock
 - 1. Where concrete is poured against undisturbed rock, especially in drilled shafts, place concrete as soon as practicable after excavation to prevent weathering of exposed rock.
 - a. For footings and slabs, place mud slabs within 4 hours after the excavation is at final grade.
 - 2. Remove all water from excavation or shaft before placing concrete.

3.08 CONSOLIDATION OF CONCRETE

- A. All concrete shall be placed and consolidated with mechanical vibrators.
 - 1. A minimum frequency of 7000 revolutions per minute is required for mechanical vibrators.
 - 2. Do not use vibrators to transport concrete within forms.
 - 3. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion, vibrate sufficiently to consolidate concrete, generally until a liquefied appearance is produced on the surface. Do not over-vibrate causing segregation.
 - 4. Keep a spare vibrator on the site during concrete placing operations.. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
- B. Concrete for slabs shall be compacted with vibrating screeds and internal vibrators.
- C. Internal vibrators shall be used; form attached vibrators are not permitted.
- 3.09 FINISHING OF FORMED SURFACES
 - A. Forms shall be removed as specified in Section 3100. Patch, repair, finish and clean concrete within 7 days of form removal in accordance with the Specifications. Cure concrete as finishing progress in accordance with the Specifications.
 - B. No Finish: A finish is not required on surfaces which are not visible from the inside or outside of the structure or more than 12 inches below finished grade
 - C. Smooth Form Finish:
 - 1. Unless otherwise specified, all surfaces not meeting the requirements for "no finish" shall receive a smooth form finish. Use a smooth form finish on all surfaces exposed to view and liquid.

- 2. Provide a smooth, hard uniform texture on the concrete surface. Use plywood or fiberboard linings or forms in as large sheets as practicable and with smooth, even edges and close joints.
- 3. Patch tie holes and defects. Rub fins and joint marks with carborundum stone to leave a smooth, unmarred finish surface.
- D. Related Unformed Surfaces: Tops of piers, walls, bent caps and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to a texture reasonably consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

3.10 FINISHING SLABS AND SIMILAR FLAT SURFACES

- A. Comply with the recommendations in ACI 302.1R for screeding, restraightening and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Finish slabs and similar flat surfaces monolithically and apply as indicated in the Plans and as follows:
 - 1. Rough Finish.
 - a. Tank floors and slabs that receive grout or additional concrete toppings.
 - b. Provide a rough surface by screeding only without further finish.
 - 2. Trowel Finish
 - a. Slab surfaces exposed to view, liquids or to be covered with a coating system, flooring coverings or membranes.
 - b. After apply float finish, apply trowel finish and consolidate by hand or power driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 3. Broom Finish
 - a. Sidewalks, walkways and platforms.
 - b. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.11 CONCRETE CURING

- A. All concrete shall be cured in accordance with the Specifications. The curing methods shall be wet curing, sheet materials or membrane curing compound. Unless the curing method is specified otherwise, select the appropriate curing method.
- B. Length of Curing Period
 - 1. A "curing day" shall be any day on which the atmospheric temperature taken in the shade, or the air temperature adjacent to the concrete, remains above 50 degrees F for at least 18 hours.
 - 2. Continuously cure concrete for a period until 7 curing days have been reached. In cold weather, curing may be terminated after a period of 14 consecutive days.

- C. Wet Curing
 - Immediately after the finishing operations are completed or forms are stripped, the concrete shall be covered with wet cotton mats or with a temporary covering of canvas or burlap, thoroughly saturated with water before placement. A temporary covering shall be used when factors dictate that cotton mats cannot be placed immediately after finishing operations without marring the finishing of the concrete surface.
 - 2. When temporary coverings are used keep them in place only until the surface has sufficiently hardened so that a cotton mat can be substituted without marring or disturbing the concrete finish.
 - 3. The coverings shall remain in contact with the concrete for the duration of the curing period.
 - 4. The coverings shall be kept saturated with water for a period of 4 days after the concrete has been placed.
 - 5. Water used for curing shall be potable and free from any injurious materials or deleterious substances.
- D. Sheet Curing
 - 1. Immediately after the finishing operations are completed or forms are stripped, install sheet curing materials in accordance with all Manufacturer's recommendations.
 - 2. Sheet curing shall be in contact with the entire concrete surface so as to prevent drying for the duration of the curing period.
 - 3. When pedestrian traffic is unavoidable, provide suitable walkways to protect the sheet material.
- E. Membrane Curing
 - 1. Membrane curing compound is not permitted on surfaces to be rubbed or on surfaces to receive additional concrete, grout, plaster or coatings.
 - 2. Immediately after the finishing operations are completed or forms are stripped, apply membrane curing compound solution under pressure with a spray nozzle so the entire exposed surface is completely covered with a uniform film. The rate of application shall insure complete coverage but shall not exceed 150 square feet per gallon of curing compound.
 - 3. After application and under normal conditions, the curing compound shall be dry to the touch within 1 hour and shall be dry thoroughly and completely within 4 hours. When thoroughly dry it shall provide a continuous flexible membrane free from cracks and pinholes and shall remain intact during the required curing period.
 - 4. If the membrane seal is broken during the curing period, immediately repair it with additional curing compound.
- F. After the curing period, the temperature of the exposed surface shall not be permitted to drop faster than 30 degrees F in 24 hours.

3.12 CONCRETE SURFACE REPAIRS

- A. Repair defective areas immediately after the removal of forms in accordance with Section 03740.
- B. If the concrete surface is bulged, uneven or exhibits defects which in the Engineer's opinion cannot be satisfactorily repaired, remove and replace the entire concrete section as directed.
- C. Patch tie holes immediately after removal of forms. After cleaning and thoroughly dampening the tie hole, fill solid with non-shrink, non-metallic grout.

3.13 FIELD QUALITY CONTROL

- A. Field Testing Services:
 - 1. ENGINEER will employ testing laboratory to perform field quality control testing for concrete. ENGINEER will direct the testing requirements.
 - 2. Testing laboratory will make standard compression test cylinders and entrained air tests as specified in this Article, under observation of ENGINEER or Resident Project Representative.
 - 3. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
- B. Quality Control Testing During Construction:
 - 1. Perform sampling and testing for field quality control during placement of concrete, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - i. In accordance with ASTM C31; make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
 - ii. Cast, store, and cure specimens in accordance with ASTM C31.
 - iii. Test and record the following when cylinders are cast: slump,
 - concrete temperature, air content, and unit weight. g. Compressive Strength Tests:
 - i. In accordance with ASTM C39; one specimen tested at seven days, and three specimens tested at 28 days.
 - ii. Adjust mix design if test results are unsatisfactory and resubmit for approval.
 - iii. Concrete that does not comply with strength requirements will be considered as defective Work.

- h. Within 24 hours of completion of test, testing laboratory will submit certified copy of test results to CONTRACTOR and ENGINEER.
- C. Evaluation of Field Quality Control Tests:
 - 1. Do not use concrete delivered to final point of placement having slump, concrete temperature, total air content or unit weight outside specified values.
 - 2. Compressive Strength:
 - a. Compressive strength tests for laboratory-cured cylinders will be acceptable if the averages of all sets of three consecutive compressive strength tests results equal or exceed specified 28-day design compressive strength of the associated type or class of concrete, and no individual strength test falls below required compressive strength by more than 500 psi.
 - b. Questionable Field Conditions During Concrete Placement:
 - i. Where questionable field conditions exist during concrete placement or immediately thereafter, strength tests of specimens cured under field conditions will be required by ENGINEER to check adequacy of curing and protecting of concrete placed. Specimens shall be molded at the same time and from the same samples as laboratory-cured specimens.
 - ii. Provide improved means and procedures for protecting concrete when 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders.
 - iii. When laboratory-cured cylinder strengths are appreciably higher than minimum required compressive strength, field-cured cylinder strengths need not exceed minimum required compressive strength by greater than 500 psi even though the 85 percent criterion may not be met.
 - iv. If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to ensure that load-bearing capacity of the structure is not jeopardized or impaired. If likelihood of low-strength concrete is confirmed and evaluations indicate load-bearing capacity may have been reduced, perform tests of cores from the concrete in question at CONTRACTOR's expense.
 - c. If compressive strength tests fail to indicate compliance with minimum requirements of the Contract Documents, concrete represented by such tests will be considered defective.
- D. Testing Concrete Structure for Strength:
 - When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42 and the following:
 - a. Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by ENGINEER.
 - b. Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified compressive

strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.

- c. Testing laboratory shall submit test results to ENGINEER on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, CONTRACTOR name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.
- 2. Fill core holes solid with non-shrink grout and finish to match adjacent concrete surfaces.
- 3. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by ENGINEER.
- E. Supplier's Services:
 - Water-Reducing Admixture Manufacturer: Furnish services of qualified concrete technician employed by admixture manufacturer to assist in proportioning concrete for optimum use of admixture. Concrete technician shall advise on proper addition of admixture to concrete and on adjustment of concrete mix proportions to meet changing conditions at the Site.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. Provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install grout.
- 1.02 RELATED WORK
 - A. Coordinate the requirements of this section with all other sections of Division 3, Concrete.
- 1.03 REFERENCE STANDARDS
 - A. American Concrete Institute (ACI)
 - 1. ACI 211.1, Practice for Selecting Proportions for Normal, Heavy-Weight and Mass Concrete.
 - 2. ACI 301, Specification for Structural Concrete.
 - B. American Society for Testing and Materials (ASTM).
 - 1. ASTM C33, Specification for Concrete Aggregates.
 - 2. ASTM C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 3. ASTM C150, Specification for Portland Cement.
 - 4. ASTM C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
 - 5. ASTM C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concrete.
 - 6. ASTM C579, Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes.
 - 7. ASTM C827, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
 - 8. ASTM C882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 9. ASTM C937, Specification for Grout Fluidifier for Preplaced-Aggregate Concrete.
 - 10. ASTM C939, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - 11. ASTM C1107, Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
 - 12. ASTM C1181, Standard Test Method for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

1.04 SUBMITTALS

- A. Grout Mix Design:
 - 1. For Grout Fill and Construction Joint Grout, submit the following:
 - a. Grout mix design
 - b. Laboratory test reports for grout strength tests.
- B. Reports and Certificates, submit the following:
 - 1. For proprietary materials, submit copies of Manufacturer's certification of compliance with the specified properties for Class I, II, and III grouts.
 - 2. Certified testing lab reports for tests specified herein for nonproprietary materials.
 - 3. Certifications that all grouts used on the project are free of chlorides or other chemicals causing corrosion.
 - 4. Manufacturer's specifications and installation instructions for all proprietary materials.
- 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING
 - A. Delivery of Materials: Grout materials from Manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels.
 - B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.
- 1.06 QUALITY ASSURANCE
 - A. Installer Qualifications: An experienced installer who has completed grout work of similar scope and complexity with similar materials as found on this Project.
 - B. Testing Agency Qualifications: An experienced independent testing agency, acceptable to authorities having jurisdiction and the Engineer that is qualified according to applicable ASTM standards to conduct the testing indicated.
 - C. Field Tests:
 - 1. Compression test specimens shall be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to ensure continued compliance with these specifications. The specimens will be made by the Engineer or its representative.
 - 2. Compression tests and fabrication of specimens for non-shrink grout shall be performed as specified in ASTM C109. A set of three specimens will be made for testing at seven days, 28 days, and each additional time period as appropriate.
 - 3. Compression tests and fabrication of specimens for epoxy grout shall be performed as specified in ASTM C579, Method B. A set of three specimens will be made for testing at seven days, and each earlier time period as appropriate.
 - 4. The cost of all laboratory tests on grout will be borne by the Owner, but Contractor shall assist in obtaining specimens for testing. However, Contractor shall be charged for the cost of any additional tests and investigation on work performed

which does not conform to the requirements of the specifications. Contractor shall supply all materials necessary for fabricating the test specimens.

- PART 2 PRODUCTS
- 2.01 GROUTS
 - A. General: Non-shrink grout shall be a prepackaged, inorganic, flowable, non-gasliberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the Manufacturer for the particular application.
 - B. Class 1 Non-Shrink Grout:
 - 1. Required minimum 28 day compressive strength is 7000 psi.
 - 2. Shall meet the requirements of ASTM C1107 and the minimum compressive strength requirements when tested using the amount of water required to achieve the following properties:
 - a. Flowable consistency (125 to 145 percent flow on ASTM C230, five drops in 3 seconds).
 - 3. The grout shall not bleed when tested at maximum allowed water.
 - 4. The non-shrink property is not based on a chemically generated gas or gypsum expansion.
 - 5. Product and Manufacturer: Provide one of the following:
 - a. Master Flow 100, as manufactured by BASF Building Systems.
 - b. Five Star Grout, as manufactured by Five Star Products.
 - C. Class 2 Non-Shrink Grout:
 - 1. Required minimum 28 day compressive strength is 7000 psi.
 - 2. Shall meet the requirements of ASTM C1107 Grades B and C and minimum compressive strength requirements when tested using the amount of water required to achieve the following properties:
 - a. Fluid consistency (20 to 30 seconds in accordance with ASTM C 939).
 - 3. The length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured at 3 or 14 days. The expansion at 3 or 14 days shall not exceed the 28-day expansion.
 - 4. The non-shrink property is not based on a chemically generated gas or gypsum expansion.
 - 5. Product and Manufacturer: Provide one of the following:
 - a. Masterflow 928, as manufactured by BASF Building Systems.
 - b. Five Star Fluid Grout 100, as manufactured by Five Star Products, Inc.
 - D. Class 3 Non-Shrink Epoxy Grout:
 - 1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not

contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted, unless specifically recommended by the Manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

- 2. Required minimum 7 day compressive strength is 13,000 psi when tested in accordance with ASTM C579.
- 3. The following properties shall be attained with the minimum quantity of aggregate allowed by the manufacturer.
 - a. The vertical volume change at all times before hardening shall be between 0.0 percent shrinkage and four percent expansion when measured according to ASTM C827 (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1). Alternately, epoxy grouts which maintain an effective bearing area of not less than 95 percent are acceptable.
 - b. The length change after hardening shall be negligible (less than 0.0006 in/in) and the coefficient of thermal expansion shall be less than 0.00003 in/in/F when tested in accordance to the requirements of ASTM C531.
 - c. The compressive creep at one year shall be negligible (less than .001 in/in) when tested under a 400 psi constant load at 140°F in accordance to the requirements of ASTM C1181.
 - d. The grout shall be capable of maintaining at least a flowable consistency for a minimum of 30 minutes at 70°F.
 - e. The shear bond strength to Portland cement concrete shall be greater than the shear strength of the concrete when tested in accordance to the requirements of ASTM C882.
 - f. The effective bearing area shall be a minimum of 95 percent.
- 4. Product and Manufacturer: Provide one of the following:
 - a. Sikadur 42 Grout Pak, as manufactured by Sika Corporation.
 - b. DP Five Star Epoxy Grout, as manufactured by Five Star Products.
- E. Grout Fill & Topping Grout:
 - 1. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 3300 shall apply except as noted otherwise herein.
 - 2. Topping grout and concrete fill shall contain a minimum of 517 pounds of cement per cubic yard (5.5 sacks) with a maximum water cement ratio of 0.45.
 - 3. Minimum 28 day compressive strength shall be 4000 psi.
 - 4. Coarse aggregate shall be No. 8 (3/8" max) per Section 03300.
 - 5. Fine aggregate shall be as required in Section 03300.
 - 6. Slump shall be adjusted to match placement and finishing conditions, but shall not exceed 4 inches.
 - 7. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
 - 8. Where grout placement is thicker than 4 inches, use Class A concrete as specified in Section 03300.

- F. Requirements for Grout Fill and Topping Grout
 - 1. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1 and report to Engineer the following data:
 - a. Complete identification of aggregate source of supply.
 - b. Tests of aggregates for compliance with specified requirements.
 - c. Scale weight of each aggregate.
 - d. Absorbed water in each aggregate.
 - e. Brand, type and composition of cement.
 - f. Brand, type and amount of each admixture.
 - g. Amounts of water used in trial mixes.
 - h. Proportions of each material per cubic yard.
 - i. Gross weight and yield per cubic yard of trial mixtures.
 - j. Measured slump.
 - k. Measured air content.
 - I. Compressive strength developed at seven days and 28 days, from not less than three test specimens cast for each seven day and 28 day test, and for each design mix.
 - 2. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Section 4.
 - 3. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301, Section 4.
 - 4. Admixtures: Use air-entraining admixture in all grout. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control. Do not use admixtures which have not been incorporated and tested in the accepted design mix, unless otherwise authorized in writing by Engineer.
- G. Grout Applications: The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise in the Drawings, grouts shall be provided as listed below.

Application	Grout Type
Beam Base Plates	Class 1
Column Base Plates	Class 2
Equipment & Tank Base Plates	Class 2
Machinery Base Plates	Class 3
Filling blockout spaces for embedded items (railing posts, gate guide frames, etc.)	Class 2
Toppings & fill 4 inches or less	Grout Fill & Topping Grout
Toppings & fill greater than 4 inches	Class A Concrete (Section 03300)
All other applications	Class 1

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 and as recommended by the Manufacturer of prepackaged grouts.
- 2.03 CONSISTENCY
 - A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application.
- PART 3 EXECUTION
- 3.01 INSPECTION
 - A. Contractor shall examine the substrate and conditions under which grout is to be placed and notify Engineer, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
- 3.02 INSTALLATION
 - A. General:
 - 1. Place grout as shown on the Drawings and in accordance with manufacturer's instructions. If Manufacturer's instructions conflict with the Specifications do not proceed until Engineer provides clarification.
 - 2. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
 - 3. Placing grout shall conform to temperature and weather limitations in Section 03300.
 - 4. Grout shall be cured following Manufacturer's instructions for prepackaged grout and the requirements in Section 03300.
 - B. Columns, Beams and Equipment Bases:
 - After shimming base plate to proper grade, securely tighten anchor bolts. Properly form around the base plates, allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the grout.
 - C. Handrails and Railings:
 - 1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the grout. Bevel grout at juncture with post so that moisture flows away from post.
 - D. Topping Grout:
 - 1. All mechanical, electrical, and finish work shall be completed prior to placement of topping grout. The base slab shall be given a roughened textured surface by sandblasting or hydro-blasting exposing the aggregates to ensure bonding to the base slab.

- 2. Apply topping grout as shown in the Drawings; the minimum thickness of grout topping shall be 1-inch.
- 3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping shall be placed until the slab is complete free from standing water. A thin coat of neat Type II cement slurry shall be broomed into the surface of the slab and topping shall be placed while the slurry is still wet. The topping shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment Manufacturer after the grout is brought to the established grade.
- 4. 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.
- 5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.
- 6. Cure and protect the grout topping as specified in Section 03300.
- E. Grout Fill
 - 1. All mechanical, electrical, and finish work shall be completed prior to placement of grout fill. Grout fill shall be mixed, placed, and finished as required in Section 03300.
 - 2. The minimum thickness of grout fill shall be 1 inch. Where the finished surface of grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3 1/2 inches wide by 1 1/2 inches deep.
 - 3. The surface shall be tested with a straight edge to verify that the surface slopes uniformly to drain and to detect high and low spots which shall be immediately eliminated. When the grout fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

END OF SECTION

SECTION 03740

MODIFICATIONS AND REPAIR TO CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to cut, remove, repair or otherwise modify parts of in-place concrete.
- B. Work under this Section may also be performed as a remedy for improperly or poorly placed concrete, or concrete damaged during construction operations. Such work shall be performed only after receiving written directions from the Engineer.
- 1.02 RELATED WORK
 - A. Division 3 Concrete
 - B. Division 5 Metals
- 1.03 REFERENCE STANDARDS
 - A. American Society for Testing and Materials (ASTM).
 - 1. ASTM C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
 - 2. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 3. ASTM C293 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
 - 4. ASTM C321 Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
 - 5. ASTM C348 Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
 - 6. ASTM C496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - 7. ASTM C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 8. ASTM C882 Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
 - 9. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
 - 10. ASTM D695 Standard Test Method for Compressive Properties of Rigid Plastics.
 - 11. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of the General Conditions and Division 1 General Requirements.
- B. Submit a Schedule of Demolition which includes the detailed methods of demolition to be used at each location.
- C. Submit a Plan of Repair for any structure that requires repair which includes the detailed methods of repair to be utilized.
- D. Submit Manufacturer's technical literature on all product brands proposed for use. The submittal shall include the manufacturer's installation and/or application instructions.
- E. When substitutions for acceptable brands of materials specified herein are proposed by the Contractor, submit Manufacturer's substitutions for approval prior to delivery to the Site. Submitted data shall demonstrate compliance with all requirements of this Specification or deviations shall be clearly noted.

1.05 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.
- B. No proposed or existing structure shall be repaired or otherwise altered until authorization is given by the Engineer. Notify the Engineer of any defects in the original construction and submit a proposed repair plan for review.
- C. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing, and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work to protect personnel, to control dust, and to prevent damage to the structures or contents by falling or flying debris.
- D. Manufacturer qualifications. The manufacturer of the specified products shall have a minimum of 5 years experience in the manufacture of such products, and shall have an ongoing program to provide training and technical support for the Contractor's personnel.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.
 - B. Store products as recommended by the Manufacturer.
- PART 2 PRODUCTS
- 2.01 GENERAL
 - A. Materials shall comply with these Specifications and any applicable federal, state or local regulations.
 - B. All materials used shall be approved for use in potable water facilities.

2.02 REPAIR CONCRETE

A. Use Class A concrete in accordance with Section 03300 for large volume repairs unless otherwise directed.

2.03 REPAIR MORTAR

- A. Repair mortar shall be a polymer modified prepackaged cementitious repair mortar.
- B. Use an appropriate product for the specific application in accordance with all Manufacturer's requirements and recommendations.
- C. Material Properties.
 - 1. Compressive strength (ASTM C109):
 - a. 3800 psi min. at 7 days.
 - b. 4800 psi min. at 28 days.
 - Splitting Tensile strength (ASTM C496):
 a. 500 psi min. at 28 days.
 - 3. Flexural strength (ASTM C78): a. 1300 psi min. at 28 days.
 - Bond strength (ASTM C882 Modified):
 a. 2000 psi min. at 28 days.
 - 5. Color to match surrounding material color which is exposed to view.
- D. Products and Manufacturers:
 - 1. SikaTop 121 Plus as manufactured by Sika Corporation.
 - 2. SikaTop 122 Plus as manufactured by Sika Corporation.
 - 3. SikaTop 123 Plus as manufactured by Sika Corporation.
 - 4. EMACO R310 CI, as manufactured by BASF.

2.04 STRUCTURAL CRACK INJECTION

- A. Concrete Sealing Epoxy
 - 1. High strength moisture insensitive epoxy system in compliance with ASTM C881, Type IV, Grade 3, Class B & C and with the following properties:
 - a. Tensile properties at 14 days (ASTM D638)
 - (i) Tensile strength: 5,500 psi
 - (ii) Minimum elongation: 2%
 - b. Compressive properties at 28 days (ASTM D695)
 - (i) Compressive strength: 10,000 psi
 - (ii) Modulus of elasticity: 300,000 psi
 - c. Flexural strength: 12,000 psi at 14 days (ASTM D790)
 - d. Compressive strength: 14,000 psi (ASTM D695)
 - e. Bond strength: 2,200 psi after 2 days (ASTM C882)
 - f. Maximum water absorption of 0.1 percent after 24 hours
 - 2. The color of the sealing epoxy shall match the existing color of surrounding concrete surfaces if exposed to view.

- B. Epoxy Injection Resin
 - 1. High modulus, low viscosity epoxy crack injection system in compliance with ASTM C881, Type IV, Grade 1, Class B&C and with the following properties:
 - a. Tensile properties at 14 days (ASTM D638)
 - (i) Tensile strength: 5,500 psi
 - (ii) Minimum elongation: 2%
 - b. Compressive properties at 28 days (ASTM D695)
 - (i) Compressive strength: 10,000 psi
 - (ii) Modulus of elasticity: 300,000 psi
 - c. Flexural strength: 12,000 psi (ASTM D790)
 - d. Bond strength: 2,800 psi after 2 days (ASTM C882)
 - e. Maximum water absorption of 0.15 percent after 24 hours

2.05 WATERPROOFING INJECTION

- A. Concrete Expansion Joint and Active Crack Sealing
 - 1. SikaFix HH Hydrophilic as manufactured by Sika Corporation.
- B. Water Infiltration Under Pressure
 - 1. SikaFix HH+ as manufactured by Sika Corporation.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Apply methods specified in this Section as indicated on the Drawings, as specified, or as directed and/or approved by the Engineer. Finishes, joints, reinforcements, sealants, etc., shall be as specified in their respective Sections of the Specifications.
 - B. All commercial products specified in this Section shall be mixed and applied in strict compliance with the Manufacturer's recommendations.
 - C. In all cases where concrete is repaired in the vicinity of an expansion joint or isolation joint, the repairs shall be made to preserve the isolation between components on either side of the joint.
 - D. When drilling holes in concrete for dowels or bolts, drilling shall stop if reinforcing steel is encountered. The hole shall be relocated to avoid reinforcing and the existing hole patched with repair mortar per this Section. Reinforcing shall not be cut. Where possible, reinforcing locations shall be identified prior to drilling using non-destructive methods such as "rebar locators", GPR, etc. so that drilled hole locations may be adjusted to avoid reinforcing interference prior to drilling.

3.02 CONCRETE REMOVAL

- A. General
 - 1. Concrete specified to be left in place which is damaged by the Contractor shall be repaired by approved means to the satisfaction of the Engineer at no cost.
- B. Concrete Removal Equipment
 - 1. Use sawing equipment capable of sawing concrete to the specified depth.
- 2. Use power driven chipping tools no heavier than a 30 lb. class for bulk concrete removal and no heavier than a 15 lb. class for removal of concrete beneath reinforcing steel or along the edges of the repair area.
- 3. Hydrodemolition equipment may be used with prior written approval of the Engineer or via an approved Schedule of Demolition.
- C. Concrete Removal Procedures and Requirements
 - 1. Concrete removal shall be initiated by first saw cutting to a depth of 1 inch (or by line drilling if saw cutting is not feasible) at the given removal limits. Remove concrete to the required depth by chipping or jack-hammering, as appropriate, in areas where concrete is to be taken out. Use the smallest equipment possible to avoid bruising or damaging concrete outside the removal zone and in accordance with this Section. Remove concrete in such a manner that surrounding concrete, existing reinforcing to be left in place and existing in place equipment are not damaged.
 - 2. All existing reinforcing exposed during concrete removal that will be covered with new material shall be undercut, exposing the entire perimeter of the bar, a minimum of 1 inch or 1.5 times the maximum aggregate size of the repair material, whichever is greater. Reinforcing to be left in place shall not be damaged during demolition.
 - 3. Where existing reinforcing is exposed due to saw cutting or core drilling and no new material is to be placed on the cut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4 inch. Reinforcing shall be drilled and ground to establish minimum cover requirements prior to application of the surface treatment.

3.03 REPAIR PREPARATION

- A. Surface Preparation
 - 1. Where bonding to existing surfaces, clean and remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by abrasive blasting, grinding, etc. as approved by the Engineer. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete.
 - 2. Where bonding new concrete to existing concrete, the existing surface shall be roughened to a minimum 1/4 inch amplitude or greater if a larger amplitude is required by the repair material manufacturer.
- B. Existing Reinforcing Steel
 - 1. Existing reinforcing which is exposed shall be cleaned by mechanical means to remove all loose material and corrosion products before proceeding with the repair.

3.04 REPAIR EXECUTION

- A. Install any required formwork in accordance with Section 03100.
- B. Prior to installing the repair concrete, or mortar, clean the concrete surface and apply mortar or epoxy bonding agents as required for Construction Joints in accordance with Section 03250. Apply a hydrophilic waterstop per Section 03250 for water retaining structures or if called for in Drawings.

- C. Install repair concrete, mortar or other repair material in accordance with all manufacturer's instructions and Section 03300. In the event of a conflict between the manufacturer's instructions and Section 03300, the more restrictive requirement shall apply.
- D. Cure the repair in accordance with all manufacturer's instructions and Section 03300. In the event of a conflict between the manufacturer's instructions and Section 03300, the more restrictive requirement shall apply.
- 3.05 EPOXY CRACK INJECTION
 - A. Flush out cracks and voids with chemical agent or chemical solvent to remove dirt and laitance prior to epoxy injection.
 - B. Provide temporary entry ports spaced to accomplish movement of fluids between ports, complying with Manufacturer's recommendations. Provide seal at concrete surface to prevent epoxy leakage.
 - C. Inject epoxy into prepared ports under appropriate pressure, using equipment appropriate for the particular application. Begin injection at lower entry port and continue until adhesive appears at adjacent entry port; continue from port to port until each crack is filled.
 - D. After epoxy adhesive has set, remove temporary seal and excess adhesive. Grind surfaces smooth.

END OF SECTION

SECTION 05051

ANCHOR BOLTS

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. This section specifies anchor bolts and embedded anchorages into concrete.
- 1.02 RELATED WORK
 - A. Division 3 Concrete
 - B. Division 5 Metals
 - C. Division 11 Equipment
 - D. Division 15 Mechanical
 - E. Coordinate work of this section with all other sections to obtain a proper installation. Review all drawings and specifications for additional requirements for anchor bolts and anchorages.
- 1.03 SUBMITTALS
 - A. Shop Drawings:
 - 1. Submit shop drawings as specified in Division 1, General Provisions. Give sufficient detail to permit anchor bolt installation without referring to design drawings.
 - 2. Drawings must include all anchor bolts and embedded anchorages, bolt setting and erection templates.
 - 3. Provide manufacturer's specifications, load tables and installation instructions.
 - 4. Erection drawings shall be sealed by a Licensed Professional Engineer in the State in which the project is will be built.
 - 5. Provide a letter sealed by a Licensed Professional Engineer in the State in which the project will be built stating that all anchor bolts and anchorages not specifically shown on the structural drawings are adequate for the application and meet all design requirements in the Drawings and referenced codes.

1.04 REFERENCE STANDARDS

- A. American Institute of Steel Construction (AISC).
 - 1. AISC 303: Code of Standard Practice for Structural Steel Buildings and Bridges.
 - 2. AISC 360: Specifications for Structural Steel Buildings.
 - 3. Steel Construction Manual.
- B. American Concrete Institute (ACI)
 - 1. ACI 318: Building Code Requirements for Structural Concrete
 - 2. ACI 350: Code Requirements for Environmental Engineering Concrete Structures
- C. International Code Council

- 1. International Building Code (IBC)
- D. American Society of Civil Engineers (ASCE)
 - 1. ASCE-7: Minimum Design Loads for Buildings and Other Structures
- E. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36 Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 5. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 6. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - 7. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 8. ASTM A490 Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
 - 9. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.
 - 10. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 11. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 12. ASTM F594 Standard Specification for Stainless Steel Nuts.
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE
 - A. If materials must be stored, keep them off the ground and clean, free of dirt, mud, grease or oil. Protect bolts and anchorages from corrosion and/or deterioration.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- PART 2 PRODUCTS
- 2.01 DESIGN CRITERIA
 - A. When the size, length, and material or load carrying capacity of the anchor bolts or anchorages are not shown in the Drawings, provide the following:
 - 1. For cast-in-place anchor bolts or anchorages:
 - a. Provide the material type, size, length, and arrangement required to resist all loads and load combinations given in the latest version of the IBC Building

Code, ASCE-07 and the Drawings. In the case of conflicting requirements, the most restrictive requirements will control.

- 2. For post-installed anchor bolts or anchorages:
 - a. Provide the material type, size, length, minimum embedment and arrangement required to resist all loads and load combinations given in the latest version of the IBC Building Code, ASCE-07 and the Drawings. In the case of conflicting requirements, the most restrictive requirements will control.
 - b. Provide required adhesive and installation requirements.

2.02 MATERIALS

- A. Anchor Bolts:
 - 1. Provide anchor bolts as shown in the Drawings.
 - 2. Provide stainless steel anchor bolts and hardware complying with ASTM F593, AISI Type 316 headed with stainless steel nuts and washers.
 - 3. For equipment, provide 316 stainless steel anchor bolts that meet the manufacturer's requirements for size and strength. Comply with manufacturer's requirements for embedment length and projection.
 - 4. Protect threads and shank from damage during placement of concrete, installation of equipment and erection of structural steel.
- B. Adhesive Anchors:
 - 1. Provide stainless steel adhesive anchors and hardware complying with ASTM F593, Condition CW, AISI Type 316 headed with stainless steel nuts and washers.
 - 2. Adhesive system shall be Hilti HIT-HY200 adhesive, by Hilti. No substitutions will be considered.
 - 3. Embedment depth of the anchor shall provide pullout strength equal to the allowable tensile capacity of the anchor, unless otherwise noted in the Drawings. Reduction in pullout strength due to spacing and edge distances shall be made.
- C. Expansion Anchors
 - 1. Expansion anchors will not be allowed structural connections unless specifically called for in the Drawings.
 - 2. Where expansion anchors are called for in other sections, provide Type 316 stainless steel expansion anchors.
 - a. Kwik Bolt by Hilti
 - b. Easy-Set by Simpson

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Assure that embedded items are protected from damage and are not filled in with concrete.
 - B. Set bolts as show in the Drawings or as required using templates or other devices to insure accurate placement and to prevent drift during concrete placement.

- C. Fully consolidate plastic concrete around anchor bolts per the requirements Division 3 Specifications.
- D. For adhesive anchors and adhesive materials, Contractor shall comply with all manufacturer's installation instructions. Properly clean out holes per manufacturer's required procedures prior to installation of adhesive.
- 3.02 CLEANING
 - A. After Embedding concrete is placed, remove protection and clean bolts and inserts.

END OF SECTION

SECTION 05500

MISCELLANEOUS METAL FABRICATIONS

- PART 1 GENERAL
- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This Section includes the following:
 - 1. Aluminum ladders.
 - 2. Shelf angles.
 - 3. Steel framing and supports for mechanical and electrical equipment.
 - 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 5. Cast stair nosings.
 - 6. Pipe bollards.
 - B. Related Sections include the following:
 - 1. Section 05120 Structural Steel for structural-steel framing system components.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Cast nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.04 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.05 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.06 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

- 2.01 METALS, GENERAL
 - A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.02 ALUMINUM FABRICATIONS

A. Aluminum Framing & Fabrications – General

- 1. Materials
 - a. Aluminum structural shapes and plates.Alloy 6061-T6
 - b. Extruded aluminum pipe.....Alloy 6063-T6
 - c. Stainless steel fasteners......ASTM A276, Type 316

2. Fabrication

- a. See general fabrication requirements in Paragraph 2.08. Fabricate miscellaneous aluminum shapes and plates as shown. Furnish welded and mitered angle frames and other fabrications complete with welded anchors attached. Furnish all miscellaneous aluminum shown but not otherwise detailed. Structural shapes and extruded items shall comply with the dimensions on the Drawings within the tolerances published by the Aluminum Association.
- b. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration of exposed aluminum surfaces.
- 3. Finishes
 - a. All exposed aluminum surfaces shall have fabricator's standard mill finish unless otherwise specified. Apply a coat of methacrylate lacquer to all aluminum before shipment.

2.03 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 572, Grade 50.
- B. Steel Pipe: ASTM A53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

- C. Stainless Steel: Where indicated on the Drawings as stainless steel (SS) use stainless steel conforming to AISI 316 for non-welded items and AISI 316L for welded items. For all stainless steel, minimum yield strength 50,000 psi.
- D. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- (14.3-mm-) wide slotted holes in webs at 2 inches (51 mm) o.c.
 - 1. Width of Channels: 1-5/8 inches (41 mm).
 - 2. Depth of Channels: As indicated.
 - 3. Metal and Thickness: Unless otherwise specified, provide galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33(Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
- E. Gray-Iron Castings: ASTM A48, Class 30 (ASTM A48M, Class 200), unless another class is indicated or required by structural loads.
- F. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47 (ASTM A47M) malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, per ASTM A316 S.S.
- G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- 2.04 PAINT
 - A. Shop Primer for Ferrous Metal: Ferrous metal shall be shop primed in conformance with the performance requirements in Specification Section 09900 Painting.
 - B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 - C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.
- 2.05 FASTENERS
 - A. General: Provide 316 stainless-steel fasteners for chemical applications exterior use and zinc-plated fasteners with coating complying with ASTM B633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
 - B. Bolts and Nuts: Regular hexagon-head bolts, ASTM stainless steel 316; with hex nuts, 316 SS; and, where indicated, flat washers.
 - C. Anchor Bolts: ASTM A193, Type 316 SS.
 - D. Machine Screws: Type 316 SS.

- E. Plain Washers: Round, Type 316 SS.
- F. Lock Washers: Helical, spring type, Type 316 SS.
- G. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.06 GROUT

- A. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C1107, specifically recommended by MANUFACTURER for heavy-duty loading applications.
- 2.07 CONCRETE FILL
 - A. Concrete Materials and Properties: Comply with requirements for Class B Concrete in Specification Section 03300 Cast-in-Place Concrete, unless otherwise indicated.
- 2.08 FABRICATION, GENERAL
 - A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
 - B. Shear and punch metals cleanly and accurately. Remove burrs.
 - C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - D. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 - G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
 - H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints,

overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

- 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.09 ALUMINUM LADDERS

- A. Materials:
 - 1. Side Rails/Safety Cages, Rail Extension, and Platform. Aluminum plates, alloy 6061-T6 or aluminum extrusions, alloy 6063-T5.
 - 2. Rungs. Knurled or serrated aluminum bars, not less than 1 ¼ inch in square section fabricated of alloy 6061-T6. Rungs shall be able to withstand a 1,000 pound concentrated load without failure.
 - 3. Side Rails. Minimum 1/4" wall thickness by 3" wide.
 - 4. Rail Extension. Minimum 3'-6" above the landing and shall be fitted with deeply serrated, square, tubular grab rails.
 - 5. Safety cage. Provide safety cage on all ladders over 20'. Fabricate cage from 3/16" by 2" aluminum bar, alloy 6063-T5.
 - 6. Landing Platform. Provide at 30' intervals above the bottom of the ladder, complete with 1 1/2" or greater diameter tubular aluminum guard rails and decks of serrated aluminum treads.
 - 7. Wall/Floor Support Brackets. Aluminum plates, alloy 6061-T6. T316 fasteners/rigid attack/locking.
- B. Acceptable Manufacturers:
 - 1. O'Keefe's Inc. Model 503
 - 2. Alaco
- C. Fixed ladders and accessories shall be certified as meeting OSHA requirements.
- 2.10 SHELF ANGLES
 - A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

- C. Galvanize shelf angles to be installed in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete, unless otherwise indicated in the Drawings.
- 2.11 MISCELLANEOUS FRAMING AND SUPPORTS
 - A. General: Provide steel framing and supports indicated and as necessary to complete the Work.
 - B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
 - 3. Furnish inserts if units must be installed after concrete is placed.
- 2.12 MISCELLANEOUS STEEL TRIM
 - A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.
 - B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.
 - C. Galvanize miscellaneous steel trim in the following locations:
 - 1. Exterior.
- 2.13 CAST NOSINGS, TREADS, AND THRESHOLDS
 - A. Fabricate units of metal indicated below in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions. Provide units with an integral abrasive finish consisting of aluminum oxide, silicon carbide, or a combination of both.
 - 1. Metal: Cast gray iron, Class 20.
 - B. Configurations: Provide units in the following configurations, unless otherwise indicated:
 - 1. Nosings: Crosshatched units, 4 inches (100 mm) wide with 1/4-inch (6-mm) lip, for casting into concrete steps.
 - C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with MANUFACTURER.

- D. Apply bituminous paint to concealed bottoms, sides, and edges of units set into concrete.
- E. Provide a plain surface texture, unless fluted or crosshatched surfaces are indicated.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Safety Tread Co., Inc.
 - 2. Balco/Metalines, Inc.
 - 3. Safe-T-Metal Co.
- 2.14 FINISHES, GENERAL
 - A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Finish metal fabrications after assembly.
- 2.15 STEEL AND IRON FINISHES
 - A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A123, for galvanizing steel and iron products.
 - 2. ASTM A153/A153M, for galvanizing steel and iron hardware.
 - B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated in Section 09900 surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with Section 09900 for shop painting.

PART 3 EXECUTION

- 3.01 INSTALLATION, GENERAL
 - A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts and other connectors.
 - B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
 - C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that

have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- E. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including MANUFACTURERs' written instructions and requirements indicated on Shop Drawings, if any.
- 3.03 INSTALLING NOSINGS
 - A. Install with anchorage system indicated to comply with MANUFACTURER's written instructions.
 - B. Center nosings on tread widths.
 - C. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- 3.04 ADJUSTING AND CLEANING
 - A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
 - B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Specification Section 09900 – Painting.
 - C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide for the furnishing of all materials, supplies, labor and equipment necessary for surface preparation and application of paints and/or protective coating materials in a safe manner with proper handling and removal and disposal of all waste materials. The work in this section includes preparing surfaces and applying protective coatings to new equipment, pumps, above grade or vault piping and valves, structural steel, masonry and concrete, and miscellaneous items.
- B. Buried steel piping shall be polyurethane coated per 09 96 00 High Performance Coatings.
- C. The term "paint" as used in this section means the protective coatings specified. Other paintings may be required in other sections of the specifications. All paint for concrete, masonry, or metal surfaces shall be especially adapted for use around a moist and humid environment and shall be applied in conformance with the Manufacturer's published specifications.
- D. Lead and chromate-base coatings containing lead, chromates and/or hazardous waste chemicals shall not be used.
 - 1. Miscellaneous requirements associated with the scope of this work include:
 - 2. Furnish all materials, equipment, supplies and accessories required in connection with the work specified herein.
 - 3. Obtain all permits necessary to complete the surface preparation and coatings work designed for this project, including removal, handling and disposal of used abrasive, hazardous and/or toxic waste materials.
 - 4. Use non-lead containing coatings that comply with all laws, regulations and ordinances of the Federal, State, and Local government including V.O.C. regulations.
 - 5. Specification covers the surface preparation and painting of all surfaces, both interior and exterior, except as otherwise or specifically excluded.
 - 6. Protect all adjacent work, vehicular traffic, property and persons from damage, i.e., over spray, overblast and spillage. Should damage occur, make provisions for repair of damage in a timely manner.
 - 7. Properly store and handle materials according to manufacturer's requirements and in compliance with applicable government regulations.
 - 8. Provide scaffolding, ladders, lighting and equipment as necessary to accomplish work. All operations, equipment and their installations shall comply with all applicable laws, regulations and ordinances. Compliance with OSHA Standards per 29 CFR 1926 and 29 CFR 1910 is to be enforced by the Contractor.
 - 9. Provide for the safety of all personnel, including but not limited to the use of explosion proof lighting and proper electrical grounding of equipment. Handling and

application of all coating materials shall be in accordance with the Manufacturer's latest material safety data sheets (MSDS) and/or product data sheets.

- 10. The Contractor shall provide daily site cleanup.
- 1.02 RELATED WORK
 - A. Division 1 General Requirements
 - B. Division 3 Concrete
 - C. Division 4 Masonry
 - D. Division 5 Metals
 - E. Division 8 Doors and Windows
 - F. Division 13 Special Construction
 - G. Division 26 Electrical
 - H. Division 40 Process Integration
 - I. Division 46 Water and Wastewater Equipment

1.03 SUBMITTALS

- A. Submittals for materials and/or systems proposed for use on this project must conform to requirements included in Section 01 33 00 and shall include, but not be limited to those items listed for each product/system below.
- B. Product Data and Shop Drawings: Submit product data, shop drawings, certificates and instructions on all protective coatings items as specified herein and in accordance with Division 1, General Requirements. Submittals shall be provided to the Owner's Representative for review.
 - 1. Manufacturer Technical Data Sheets for all paints, coatings, solvents, detergents and degreasers proposed.
 - 2. Manufacturer Material Safety Data Sheets (MSDS) for all paints, coatings, and thinners proposed.
 - 3. Color name and/or number with color chart for each specific coating product. Exterior topcoat color shall be selected by the Owner.
- C. Product Data: Complete data on each type and kind of paint and primer shall be submitted for review. Submittal data shall show where and for what uses each paint product is to be used, with cross reference made to paragraphs of the specifications or the coating schedule. Data submitted on each type and kind of paint product shall include information to show that the product meets the detailed requirements of these specifications.
- D. Manufacturer's Instructions: The Manufacturer's published instructions, for use as a guide in specifying and applying the Manufacturer's proposed paint, shall be submitted. Paint shall not be delivered to the job site before review of the Manufacturer's instructions by the Owner's Representative. A Manufacturer's paint will not be

considered for use unless that Manufacturer's published instructions meet the following requirements:

- E. The instructions must have been written and published by the Manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this contract.
- F. All limitations, precautions and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended, that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall include, but not be limited to, the following:
 - 1. Surface preparation.
 - 2. Methods of application.
 - 3. Number of coats.
 - 4. Thickness of each coat.
 - 5. Total thickness.
 - 6. Drying time of each coat, including primer.
 - 7. Drying time of final coat before placing in service.
 - 8. Time allowed between coats.
 - 9. Primer required to be used.
 - 10. Primers not permitted.
 - 11. Use of a primer.
 - 12. Compatible topcoats.
 - 13. Thinner and use of thinner.
 - 14. Weather limitations during and after application (temperature, humidity, wind velocity).
 - 15. Protection from sun.
 - 16. Physical properties of paint, including percent solids content by volume, ingredient analysis, and weight per unit surface per dry mil thickness.
 - 17. Cathodic disbonding limitations, if any.
 - 18. Equipment settings (air cap, fluid tip, equipment pressure settings, etc.).
 - 19. Manufacturer's specific ventilation requirements for products used on interior surfaces. Ventilation requirements shall be provided to ensure adequate evacuation of solvents to prevent solvent entrapment, worker exposure to solvents above the OSHA PEL and to provide for timely coating system cure.
 - 20. Manufacturer's statement of conformance with ANSI/NSF 61 (NSF International) requirements for use on potable water mains.
 - 21. Cleanup Procedures: Prior to the field cleaning or painting of any surface, the Contractor shall present a written plan to the Owner and Owner's Representative for review concerning how paint and/or abrasive damage to automobiles and property will be handled, including a process for quick removal of the paint or

abrasive, and who will do the work. This approval in no way shall relieve the contractor from the responsibility of settling claims for damage, but is intended as an avenue to expedite and minimize said claims.

22. Containment Procedures: Prior to the field cleaning or painting of any surface, the Contractor shall present a written plan to the Owner and Owner Representative for review concerning how spent cleaning debris and/or paint over spray or droplets will be contained/confined to the jobsite and tank site during the surface preparation and coating application operations. Reasonable care shall be exercised by the Contractor to prevent damage, nuisance, or hazardous conditions to adjacent or nearby property owners.

1.04 REFERENCE STANDARDS

- A. ASTM D16 Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. NACE (National Association of Corrosion Engineers) Industrial Maintenance Painting.
- C. NPCA (National Paint and Coatings Association) Guide to U.S. Government Paint Specifications.
- D. PDCA (Painting and Decorating Contractors of America) Painting Architectural Specifications Manual.
- E. SSPC (Society for Protective Coatings) Society for Protective Coatings Standards.
- F. Materials to be used in contact with the raw water or potable water process stream shall meet the current requirements of the Food and Drug Administration Document, Title 21, Section 175.300 or have been approved by the EPA for potable water use and have been certified by the National Sanitation Foundation for Standard 61 listing. Submit certification that the material meets these requirements.

1.05 QUALITY ASSURANCE

- A. Materials:
 - 1. All coating materials required by this section shall be provided by a single manufacturer, unless otherwise required or approved.
 - 2. For each individual system: Provide primer and other undercoat paint produced by the same manufacturer as finish coat.
- B. Applicator: Firm with not less than 3 years of successful experience in painting work similar in scope to work of this project.
 - 1. Maintain throughout duration of the work a crew of painters who are fully qualified to satisfy requirements of the specifications.
- C. Containing Cleaning Debris and Overspray: The Contractor shall ensure that no spent cleaning/blasting debris, dust, overspray, coating droplets, or emissions of any kind, escape to the atmosphere, or adjacent buildings, private property, work sites and parking lots.

- 1. The ground and floor shall be protected from any material scrapped, sanded or removed in any fashion and the material shall be collected and properly disposed of by the contractor.
- 2. The Contractor shall be responsible for all materials that are used and for any apparatus used to contain dust, emissions, debris, overspray, and coating droplets.
- 3. If tarps are used as part of the containment system, the tarps shall be an impervious, solid, flame-resistant material, reinforced with a fiber mesh and shall allow as much light as possible to pass through the material.
- 4. The Owner reserves the right to stop work or to require additional or different containment methods if the Contractor's operations create a nuisance beyond the site property line in the sole opinion of the Owner, the Owner's designated representative, any regulatory agency, or neighbor. All costs of providing an adequate containment system shall be included by the Contractor in the Base Price Proposal.
- 5. Review of the containment system for containing the spent cleaning dust, debris, emissions, overspray, and coating droplets shall not warrant the structural integrity of the containment system and shall not warrant the structural integrity of the facility to support the containment system. Nor shall review of the containment system warrant the ability of the system to contain spent cleaning dust, debris, emissions, and overspray.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE
 - A. All paints, coatings, and related materials shall be delivered to the job site or Fabrication shop in original unopened containers with the product name, type and batch number, color, and manufacturer date clearly marked on each container.
 - B. All materials used on the job by the Contractor shall be stored in a single place provided by the Contractor or designated by the Owner's Representative at the job site. On site and fabrication shop storage shall comply with OSHA requirements, recommendations of the National Fire Protection Association, City Fire Codes, and manufacturer recommendations.
 - C. Oily or solvent-soaked rags and all waste shall be removed from the job site every night, and all necessary precautions shall be taken to reduce fire hazards to a minimum.
 - D. Deliver products to site in original, unopened, and labeled containers; inspect to verify acceptability.
 - E. Container label to include Manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
 - F. Store materials in an accepted location which meets the Manufacturer's storage requirements. Recommended storage temperatures and ventilation shall be maintained. Keep the storage area clean and repair any damage done. Remove oily rags, waste, or other fire hazards from buildings each night; take adequate precautions to avoid damage by fire. Place cloths and cotton waste which might constitute a fire hazard in metal containers or destroy at the end of each workday.

- G. Upon completion of the work, if the storage space was a fixed part of the project, it shall be left clean. Any damages to such storage space or its surroundings shall be repaired by the Contractor.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 EXTENDED WARRANTY
 - A. The Contractor and coating manufacturer shall jointly and severally warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of 2 years commencing on the date of final acceptance of the work.
- 1.10 EXCLUSIONS
 - A. Unless otherwise specified, painting will not be required on the following items:
 - 1. Exposed surfaces of aluminum
 - 2. Polished or finished stainless steel
 - 3. Nickel, Monel, Copper, Bronze, Lead or Brass
 - 4. Rubber and plastic including fiberglass reinforced plastics
 - 5. Chromium plated surfaces
 - B. If contractor applies paint to or causes damage to surfaces to be protected, or unspecified surfaces, removal of coating, repair or replacement of item is required.
- 1.11 SCHEDULING
 - A. Perform painting work according to the contract construction schedule as required in Section 01300 Submittal Procedures.
 - B. Scheduling shall not negate any requirements of temperature and/or humidity specified by the manufacturer of the coatings to be used.
 - C. Coordinate work of other trades and provide conditions for neat, clean, dust-free work.
- 1.12 SAFETY AND HEALTH REQUIREMENTS
 - A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and Manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personal protective lifesaving equipment for persons working on or about the project site.
 - B. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to the degree a hazard does not exist. Forced air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
 - C. Whenever the occupational sound levels exceed the OSHA Standard 29 CFR 1926.52, the Contractor shall implement exposure control measures that protect employee hearing against the affects from these sound levels. One such control measure can be the use of hearing protective devices.

- D. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Owner's Representative, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination purposes shall be determined by the Owner's Representative.
- 1.13 REGULATORY REQUIREMENTS
 - A. Conform to applicable code for flame and smoke rating requirements for finishes.
 - B. Conform to code 29 CFR 1910.1200 for Hazard Communication.
- PART 2 PRODUCTS
- 2.01 COLOR SCHEDULE
 - A. Final color selection will be made by the Owner's Representative from color chips submitted by the Contractor; colors selected may or may not be a Manufacturer's standard color. Submit color charts to Owner at least 60 days prior to paint application to allow time for color selection.
 - B. Shop Painted Equipment: Motors, equipment, pumps, valve bodies and metal pump bases shall be shop painted, unless specified otherwise.
 - 1. Motors, equipment, pumps, pump bases and valve bodies shall be painted color as selected by the Owner.
 - 2. All bronze or stainless steel valve bodies shall not be painted.
 - C. Moving Parts and Guards.
 - 1. Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor, fan shafts, etc.
 - 2. Contractor shall coordinate with Owner on color selection prior to painting guards or shields.

2.02 TEST EQUIPMENT

- A. The Owner's Representative will use, but is not limited to, the following pieces of equipment to determine film thickness and presence of flaws. The Contractor shall provide, maintain and calibrate the following equipment for the Owner's Representative use for testing the coating system. All costs related to the testing equipment shall be borne by the Contractor.
- B. Electronic Digital Readout Gage: 0.40 mils film thickness gage including a set of 0.5 Department of Commerce, Bureau of Standards Film Thickness Calibration Standards from 0-8 mils and 10-25 mils or equivalent.
- C. Wet Sponge Holiday Detector: Low voltage (67-1/2 volts) flow detector (holiday detector).
- D. Clemtex Comparator: Surface anchor profile standard.
- E. Wet Film Thickness Gage.

- F. Sling Psychrometer.
- 2.03 MATERIALS AND MANUFACTURERS
 - A. Paint shall arrive on the job ready-mixed, except for the tinting of undercoats, field catalyzed coatings, and possible thinning.
 - B. All coating shall meet all Federal, State, United States Corps of Engineers, Environmental Quality Board, and any other local governmental ordinances and regulations for allowable Volatile Organic Compounds and other hazardous contents.
 - C. When thinning coating, the amount of thinner used shall not exceed the limit recommended by the Manufacturer, nor shall it cause the paint to exceed the allowable limits for VOCs. Only thinners recommended by the Manufacturer's, or approved equal, shall be used.
- 2.04 COATING SCHEDULE
 - A. General:
 - 1. Coat materials as called for in the Drawings and as specified in this Section.
 - 2. All finished coatings on horizontal surfaces must be non-skid, slip-resistant.
 - 3. DFT: Dry Film Thickness.
 - B. Ferrous Metal, Interior, Non-Immersed, Subject to Non-Abrasive Conditions:
 - 1. General. All interior above ground ferrous surfaces subject to dry non-abrasive conditions shall be painted in accordance to the following provisions. This includes, but is not limited to: exposed pumps, exterior of valves, pipes, motors, machinery, and miscellaneous metals such as structural steel.
 - 2. Surface Preparation. SSPC SP-6 Commercial Blast Cleaning, Reference Part 2.02 Surface Preparation, item D for description.
 - 3. Coating (Epoxy-Polyamide)

Minimum Coverage	Mfg
Primer 5.0 mils *DFT	Tnemec, N69 High Build Epoxoline II Carboline, 893 Polymid Epoxy Primer
Finish Coat 5.0 mils DFT	Devoe, Devran 224 HS Tnemec, N69 Hi-Build Epoxoline II Carboline, 134 HS Polyurethane
	Devoe, Devian 224 NS

- * DFT Dry Film Thickness
- C. Ferrous Metal, Exterior, Non-Immersed, Subject to Non-Abrasive Conditions:
 - 1. General. All exterior ferrous surfaces not submerged, and subject to non-abrasive conditions shall be painted in accordance to the following provisions. This includes but is not limited to: Exterior of non-submerged equipment, valves, pipes, pipe sleeves, brackets, grates, structural steel, light poles, exterior face of overhead doors, etc. Surfaces intermittently or partially submerged will be treated as submerged.

- 2. Surface Preparation. SSPC SP-6 Commercial Blast Cleaning. Reference Part 2.02 Surface Preparation D for description.
- 3. Coating (Aliphatic-Polyurethane System)

<u>Minimum Coverage</u>	Mfg
Primer 5.0 mils DFT	Tnemec, N69 Hi-Build Epoxoline II Carboline, 890 Epoxy Devoe, Devran 224 HS
Finish Coat 4.0 mils DFT	Tnemec, 750-Color Endura-Shield Carboline, 134 HS Polyurethane Devoe, Devthane 359 DTM

- D. Ferrous Metals, Immersed or Subject to Abrasive Conditions
 - General. All ferrous surfaces below ground level, submerged, or subject to abrasive conditions shall be painted in accordance with the following provisions. This includes but is not limited to: Ladders, grates, checkered plates, handrails, access covers, exterior of submerged valves, piping, brackets, structural steel, sluice gates, roller gates, drains, etc. (Surfaces that are questionable as to if they are subject to submerged or abrasive conditions will be considered as subject to those conditions).
 - 2. Surface Preparation. SSPC SP-10 Near White Metal Blast Cleaning. Reference Part 2.02 Surface Preparation Ferrous Metal D for description.
 - 3. Coating (Epoxy-Polyamide System)

Minimum Coverage	Mfg
Primer 5.0 mils DFT	Tnemec, N140-1255 Pota-Pox Plus Primer Devoe, Bar-Rust 233H Carboline Carboguard 61
Finish Coat 5.0 mils DFT	Tnemec, N140-11WH Pota-Pox Plus Finish Devoe, Bar-Rust 233H Carboline Carboguard 61

- E. Non Ferrous Metal Interior:
 - 1. General. All non-ferrous surfaces where painting is required shall be painted in accordance with the following provisions. This includes but is not limited to: pipe supports, underside of roof decks and service doors.
 - 2. Surface Preparation. SSPC-SP6 Commercial Blast Cleaning. Reference Part 2.02 Surface Preparation D for description.
 - 3. Coating (Epoxy-Polyamide System)

Minimum Coverage

Primer Coat 4.0 mils DFT

Mfg

Tnemec, N69 Hi-Build Epoxoline II Devoe, Devran 205 Carboline Carboguard 60

Finish Coat 5.0 mils DFT	Tnemec, N69 Hi-Build Epoxoline II Devoe, Devran 224HS Carboline Carboguard 60	
Finish Coat (For Exterior	Tnemec Series 73 Endura-Shield	
Installation) 3.0 mils DFT in	Devoe, Devthane 359	
addition of Primer and Finish	Carboline Carbothane 134HG	
Coat described above		

- F. Aluminum, Stainless Steel, Galvanized Steel, Copper, or Brass: Unless specifically called out, only clean these surfaces. Do not paint.
- G. All Aluminum in Contact with Dissimilar Materials:
 - 1. Surface Preparation. Remove all foreign matter and apply sealer as required by coating Manufacturere.

Mfg

2. Coating (Epoxy-Polyamide)

Minimum Coverage

Primer (not required)

Finish Coats - 2 coats at 4.0 mils each

Tnemec, 66 Hi-Build Epoxoline Carboline, 890 Epoxy Devoe, Devran 224 HS

- H. Interior Concrete: Unless specifically called out or in feed room containment areas, only clean these surfaces. Do not paint.
- I. Exterior Concrete Exposed.
 - 1. Surface Preparation: Remove all grease, oils and grime by washing with an emulsifying alkaline waterbase cleaner. All surface contaminants including existing coatings shall be removed prior to application of new coating. Brush blast or acidetch concrete prior to coating. Surface preparation shall be as per Manufacturer's recommendations.
 - 2. First coat: Tnemec none required, or Devoe Decraflex 300 Elastomeric System at 12 dry mils or Carboline Flexxide @ 12 mils DFT.
 - Second coat: Tnemec Series 156 Enviro-Crete applied at 8 dry mils, or Devoe Decraflex 300 Elastomeric System at 12 dry mils or Carboline Flexxide @ 12 mils DFT.
 - 4. Third Coat: Tnemec Series 157 Enviro-Crete applied at 9 dry mils, or Devoe Decraflex 300 Elastomeric System at 12 dry mils or Carboline Flexxide @ 12 mils DFT.
- J. Concrete Secondary Containment and in any other locations called for in the Drawings for the following chemicals:
 - 1. Sodium Hydroxide (25% conc.)
 - 2. Sodium Hydroxide (12.5% conc)

3. Manufacturers: Tnemec or Sausersain

Sauereisen ConoFlex Urethane	
Surface Preparation	Refer to Sauereisen data sheets and instructions for the area preparation, application, and setting/curing requirements.
First Coat	ConoPrimer No. 502 - 8 mils DFT.
Second Coat	ConoFlex Urethane No. 381 - 60 mils DFT
Or	
Tnemec High-Build Epoxoline	
Surface Preparation	Allow new concrete to cure 28 days. Abrasive blast as per SSPC-SP13 Surface Preparation of Concrete, achieving a surface profile equal to ICRI CSP 3 to 5. All surfaces shall be dry, clean and free of dust, dirt, oil, grease and other contaminants. Fill all voids, divots and cracks with Tnemec Series 215 Surfacing Epoxy and strike flush with adjacent surfaces.
First Coat	Series 66HS Hi-Build Epoxoline 4.0 to 6.0 DFT.
Second Coat	Series 66H Hi-Build Epoxoline 4.0 to 6.0 DFT
Third Coat	Series 104 H.S. Epoxy 6.0 to 8.0 DFT
Or	
01	
Tnemec Tneme-Glaze	
Tnemec Tneme-Glaze	Allow new concrete to cure 28 days. Abrasive blast as per SSPC-SP13 Surface Preparation of Concrete, achieving a surface profile equal to ICRI CSP 3 to 5. All surfaces shall be dry, clean and free of dust, dirt, oil, grease and other contaminants. Fill all voids, divots and cracks with Tnemec Series 215 Surfacing Epoxy and strike flush with adjacent surfaces.
Tnemec Tneme-Glaze Surface Preparation First Coat	Allow new concrete to cure 28 days. Abrasive blast as per SSPC-SP13 Surface Preparation of Concrete, achieving a surface profile equal to ICRI CSP 3 to 5. All surfaces shall be dry, clean and free of dust, dirt, oil, grease and other contaminants. Fill all voids, divots and cracks with Tnemec Series 215 Surfacing Epoxy and strike flush with adjacent surfaces. Tenemec Series 201 Epoxoprime 6.0 to 8.0 DFT

K. Interior Concrete Block Masonry - Exposed.

1. Surface Preparation: Remove all oil, grease, and other contaminants. Allow mortar to cure for 14 days. Surface preparation shall be as per Manufacturer's recommendations.

- 2. First coat: Tnemec Series 130 Enviro-fill cementious block filler applied at 65-75 square feet per gallon, or Devoe Bloxfill 4000 applied at 50-75 SF per gallon or Carboline Sanitile 100 applied @ 50-75 sq per gallon.
- 3. Second coat: Tnemec Series 287 Enviro-Pox applied at 2-3 mils DFT, or Devoe Tru-Glaze 4406 applied at 3-5 mils DFT or Carboline Sanitile 555 applied @ 3-5 mils DFT.
- 4. Third coat: Tnemec Series 297 Enviro-Glaze applied at 2-3 mils DFT, or Devoe Tru-Glaze 4406 applied at 3-5 mils DFT or Carboline Carbothane134WB Applied 2.0-2.5 mils DFT.
- L. Exterior Concrete Block Masonry Exposed.
 - 1. Surface Preparation: Remove all oil, grease, and other contaminants. Allow mortar to cure for 14 days. Surface preparation shall be as per Manufacturer's recommendations.
 - 2. First coat: Tnemec Series 130 Enviro-fill applied at 85-115 SF per gallon, or Carboline Sanitile 100 applied @ 50-75 sq per gallon.
 - 3. Second coat: Tnemec Series 6 Tneme-Cryl applied at 4-6 dry mils, or Carboline Sanitile 155 applied @ 10-12 mils DFT.
 - 4. Third coat: Tnemec Series 6 Tneme-Cryl applied at 4-6 dry mils, or Carboline Sanitile 155 applied @ 10-12 mils DFT.
- M. Interior PVC Pipe
 - 1. Surface Preparation. As recommended by MANUFACTURER.

2. Coating (Epoxy-Polyamide) <u>Minimum Coverage</u> Primer (not required) Finish Coat 4.0-6.0 mils DFT

Mfg

Tnemec, N69 Hi-Build Epoxoline II Devoe, Devran 224 HS Carboline Carboguard 60

- N. Exterior PVC Pipe
 - 1. Surface Preparation: As recommended by MANUFACTURER.
 - 2. Coating (Hybrid-Polyurethane System). <u>Minimum Coverage</u>

Mfg

Primer 4.0 - 6.0 mils DFT

Tnemec, N69 Hi-Build Epoxoline II Devoe, Devran 224 HS Carboline Carboguard 60

Finish Coat 3.0-4.0mils SFT

Tnemec, 73-Endura-Shield Devoe, Devthane 379 UVA Carboline Carboline 133HB

PART 3 EXECUTION

3.01 WORK CONDITIONS

- A. Coating or painting shall be applied per manufacturer's recommendations.
- B. Surface: If surfaces to be painted cannot be put in proper condition for painting by customary cleaning and sanding operations, notify the Owner's Representative in writing or assume the responsibility for and rectify any unsatisfactory finish resulting from application to an unsatisfactory surface. Do not proceed with surface preparation or coating application until adverse conditions are corrected to provide an acceptable surface. The paint supplier shall inspect and certify all surfaces prior to coating application. Do not apply paint to a wet or damp surface.
- C. Equipment: The Contractor's coating and painting equipment shall be designed for application of the materials specified and shall be maintained in good working order comparable to that described in printed instructions of the coating manufacturer. Clean equipment thoroughly before and after use with the appropriate cleaning solution indicated by the coating manufacturer. All gages and controls on spray equipment shall be in proper working order at all times and the gages must be operational and readable.
- D. Warnings: Display caution signs in necessary areas advising of spray painting and warning against open flames.
- E. Barriers: Provide barriers or shelters on windy days to protect equipment and treatment facilities.
- 3.02 SURFACE PREPARATION
 - A. Surface preparation standards are as described in this specification. The Steel Structures Painting Council, Surface Preparation Specification is used for steel and as a guide for concrete.
 - B. Solvent Cleaning: Remove oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action, in accordance with Steel Structures Painting Council Surface Protection Specifications (SSPC) SP-1. Care must be taken to not allow solvent chemicals to enter treatment processes.
 - C. Hand Tool Cleaning: Remove all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.
 - D. Grinding: Remove weld splatter and rough edges and grind rough welds so that all surfaces are in proper condition, in the opinion of the Owner's Representative, to receive the specified coating.
 - E. Abrasive Grit Cleaning: All abrasive blasting shall be done at the shop in accordance with SSPC-SP 10 near white metal blast. No abrasive blasting shall be allowed at the job site.
 - F. Alternative surface preparation methods and materials shall be approved by the Owner's Representative before use. Contractor shall protect all electrical components from entrance of paint, solvents, or blast mediums into the cabinets. Contractor shall be

responsible for any damage to switches, contacts, and other electrical controls if contaminated by blast media during painting operations.

3.03 INSPECTION

- A. Inspection:
 - 1. The Contractor shall provide OSHA-approved staging, scaffolding and lighting as required to permit proper inspection as outlined in these specifications.
 - 2. Surface preparation, coating application and repairs are subject to inspection by the Owner and Owner's Representative. The standards published by the Steel Structures Painting Council, especially SSPC-VISL-635, Pictorial Surface, will be used as guides for acceptance or rejection of the cleaning, painting or coating application. Particular attention will be given hard-to-reach areas, bolted connections, supports, anchor bolts and threaded joints.
 - 3. A magnetic-type dry film thickness gage, and an electrical holiday detector will be used to determine the acceptability of the paint application. Calibration of the magnetic thickness gage will be done on the site using the U.S. Department of Commerce, Bureau of Standard Film Thickness Calibration Standards.
 - 4. Give sufficient notice in advance of coating applications so that the Owner and Owner's Representative can perform the following inspections:
 - a. Examination and approval of surface preparation prior to any coating.
 - b. Examination and approval of each coat prior to application of the next coat.
 - c. Inspection of the completed coating for runs, overspray, roughness, and any evidence of improper application.
 - d. Direction or observation of testing.

3.04 FIELD TESTING

- A. Contractor shall be responsible for and shall bear all the costs to perform the quality control tests for the coating.
- B. Should any paint system fail to pass a test, the Contractor shall make necessary changes approved by the Construction Manager for the corrective measures. The paint system will then be retested.
- C. The following tests will be conducted:
 - 1. Dry film thickness will be tested after each coat of paint has been applied, and after final coat of the exterior system has been applied to the pump, motor, piping, equipment, metal and appurtenances. A test will be made for every 25 square feet of surface and at locations designated by the inspector.
 - 2. All submerged paint systems will be tested for holidays after the final coat has been applied.
 - 3. Warranty Inspection: Warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Owner and Owner's Representative.

3.05 FIELD PAINTINIG

- A. Mix and thin paints in strict accordance with manufacturer's directions.
- B. At the time of application, paint must show no signs of hard settling, excessive skinning, livering, or other deterioration.

3.06 PROTECTION

- A. Protect surfaces and installations requiring no painting or finishing by use of drop cloths, masking or other approved precautionary measures. Repair or replace property and work of other trades damaged, marred or stained by painting and finishing operations.
- B. Prior to surface preparation and painting operations, remove, mask or otherwise protect hardware, hardware accessories, machined surfaces, plates, light fixtures and similar items not to be painted but which are in contact with painted surfaces.
- C. Mask openings in motors to prevent paint and other materials from entering the motors.
- D. Protect spaces used for mixing or storage of paint materials from damage or staining. Leave space in clean, neat condition.

3.07 COATING APPLICATION

- A. Manufacturer's Representative: The coating manufacturer will be responsible, through an authorized representative, to provide technical assistance to the paint Contractor as needed.
- B. Workmen: Employ workmen skilled in structural steel, piping, and mechanical equipment painting.
- C. Materials:
 - 1. Coating materials, abrasive grit, and equipment used in painting and blasting are subject to inspection at any time by the Owner's Representative and Construction Manager.
 - 2. Remove blasting grit and dust from the surface to be painted before paint application is begun.
 - 3. Dust, dirt, oil, grease, or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- D. Application:
 - 1. Priming: Not later than during the same day and before the formation of rust, the cleaned exterior surfaces shall be primed with the specified primer.
 - 2. Intermediate Coat: All primed exterior surfaces shall be given a full intermediate coat of the specified paint.
 - 3. Finish Coat: After adequate curing of the intermediate coat, the entire exterior surfaces shall then be given a final coat of the selected paint in the selected color.
- E. Paint Coating Methods:
 - 1. Finished surfaces must be free from runs, drips, ridges, waves, laps, brush marks and variations in color, texture and finish.

- 2. Double-lap all welds. Apply prime coat by brush to all weld areas; then apply prime coat to entire surface, including weld areas, by spray, roller or method selected.
- 3. Coat areas with a uniform film, free of sags, runs, or brush marks.
- 4. Except where otherwise specified, thin paint only as necessary for workability of coating material in accordance with manufacturer's printed instructions. Use only an appropriate thinner as recommended by the paint manufacturer.
- 5. When paint is being applied to any other closed areas, provide adequate ventilation.
- 6. Comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The Contractor must fully inform all members of his field crew of these recommendations.
- 7. Where inspection shows that the specified thickness is not developed, apply additional coats in accordance with the manufacturer's surface preparation and cure schedule requirements to produce the required film thickness.
- 8. Repair and recoat improper applications as recommended by the manufacturer or as required by the Construction Manager.
- 9. Factory finished items shall be protected against damage during transit, storage and erection. Damaged areas must be refinished as the original. The following items shall receive final finish at the factory, colors to be reviewed by the Owner and Owner's Representative.
 - a. Electrical panels (to be factory painted ANSI No. 61 gray).
 - b. Light fixtures.
 - c. Pressure gages.
 - d. Instrumentation.
 - e. Valves and accessories
 - f. Mechanical equipment with standard factory finish, subject to Owner's Representative's review.
- 10. The following items shall not be painted unless otherwise specified:
 - a. Aluminum, brass, bronze, chrome, copper or stainless steel.
 - b. Nameplates or serial numbers.
 - c. Grease fittings.
 - d. Valve operator stems.
 - e. Buried or encased piping or conduit.
 - f. Concrete floors, interior walls and slabs.
 - g. Glass.
 - h. Fiberglass doors, grating and handrail.
 - i. Existing and new corrugated metal wall panels.
 - j. Exterior split faces concrete masonry units.
- 11. Finish exterior doors on tops, bottoms, and side edges the same as the exterior face.
- 12. Sand lightly between each succeeding enamel or varnish coating.
- 13. Allow sufficient time between successive coatings to permit proper drying.

F. Cleaning: Upon completion of the work, remove all staging and scaffolding. Dispose of all used grit, containers and rubbish in a suitable manner. Remove overspray, paint spots, oil or stains on adjacent surfaces. Leave the entire job clean and acceptable.

END OF SECTION

SECTION 09901

EPOXY LINING FOR CONCRETE SURFACES

PART 1 GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide all labor, materials, and equipment necessary to provide and apply resinous (epoxy) resurfacing materials as specified and as indicated on drawings. Items to receive coating are:
 - 1. All interior concrete surfaces of manholes.
 - 2. All interior concrete surfaces of the lift station.

1.02 REFERENCES

- A. This section contains references to the documents listed below. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.
- C. Referenced publications found within this specification shall be the latest revision unless otherwise specified; and applicable parts of the referenced publications shall become a part of this specification as if fully included.

Reference Title

ASTM (American Society for Testing and Materials)

ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM D 3960	Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D 4259	Practice for Abrading Concrete.
ASTM E 337	Standard Practice Test Method for Measuring Humidity with a Psychrometer.

FEDERAL STANDARD COLORS

F 595 B	Federal Standard Colors
Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

Reference Title

ICRI (International Concrete Restoration Institute)

Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for
Guideline No. 03732	Sealers, Coatings, and Polymer Overlays

NACE (National Association of Corrosion Engineers)

NACE Pi 6D-173	ublication	"A Manual for Painter Safety"
NACE Pt 6G-164	ublication	"Surface Preparation Abrasives for Industrial Maintenance Painting"
NACE Pi 6G-164	ublication	"Surface Preparation Abrasives for Industrial Maintenance Painting"
NACE Pu TPC2	ublication	Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
NACE Pt 6F-163	ublication	"Surface Preparation of Steel or Concrete Tank Interiors"
NACE	RP0892-92	Standard Recommended Practice, Lining over Concrete in Immersion Service.
NACE	RP0288-88	Standard Recommended Practice, Inspection of Linings on Steel and Concrete.
SSPC (S	teel Structures	Painting Council)
SSPC-SI	P12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Recoating.
SSPC-SI	P13	Surface Preparation of Concrete
SSPC-P	A-3	"A Guide to Safety in Paint Application"
SSPC-G	uide 12	Guide for Illumination of Industrial Painting Project.
OSHA (C	Occupational Sa	fety & Health Administration.)
1915.35		Standards – 29 CFR – Painting.
ANSI (Ar	merican Nationa	Il Standards Institute)
ANSI/AS Exhaust	C 29.4 Systems	Abrasive Blasting Operations – Ventilation and Safe Practice

1.03 QUALITY ASSURANCE

A. Requirements:

- 1. Do not use or retain contaminated, outdated, or diluted materials for resurfacing. Do not use materials from previously opened containers.
- 2. Use only products of the approved Manufacturer. Use products of one manufacturer in any one resurfacing system with compatible materials. Provide same material product for touch-up as for original material.
- 3. If any requirements of this specification conflict with a referenced standard, the more stringent requirement shall apply.
- 4. Make available all locations and phases of the work for access by the Engineer or other personnel designated by the Engineer. The Contractor shall provide ventilation and egress to safely access the coating work areas for inspection.
- 5. Conduct work so that the resurfacing system is installed as specified herein. Inspect work continually to ensure that the resurfacing system is installed as specified herein. The Contractor shall inspect the work to determine conformance with the specifications and referenced documents. The Contractor shall inform the Engineer of the progress and the quality of the work through daily reports as specified below. Any nonconforming coating system work shall be corrected as specified herein or as recommended by the Manufacturer.
- 6. Summarize test data, work progress, areas covered, ambient conditions, quality control inspection test findings, and other information pertinent to the resurfacing system installation in daily reports to be submitted to the Engineer or the Engineer's Representative.
- 7. The methods of construction shall be in accordance with all requirements of this specification.
- 8. Employ only tradespeople who have at least five years of experience performing resurfacing work of similar size and complexity as the work specified in this Section. Submittals to verify these qualifications are to be made within thirty (30) days of the Notice-to-Proceed and are subject to approval by the Engineer

1.04 SUBMITTALS

- A. Submit the following prior to commencing with any phase of the work covered by this Section:
 - 1. Manufacturer's current printed recommendations and product data sheets for all coating system products supplied under this section including performance criteria, surface preparation and applications, volatile organic compound (VOC) data, and safety requirements.
 - 2. Material Safety Data Sheets (MSDS) for any materials brought on-site including all resurfacing system materials, solvents, and abrasive blast media.
 - 3. Storage requirements including temperature, humidity, and ventilation for resurfacing system materials.
 - 4. Manufacturer's requirements, including application procedures for resurfacing materials shall be in writing and shall be followed in detail. All safety precautions recommended by the Manufacturer shall be strictly adhered to at all times when work is in progress.
 - 5. Color samples for all surfaces to be resurfaced that have been field-matched to existing colors.
 - 6. Submit applicators' certification that resurfacing materials comply with Federal, State, and Local regulations for VOCs (Volatile Organic Compounds).

- 7. Submit daily reports that contain the following information: Substrate conditions, ambient conditions, application procedures, work completed and location thereof. Mark-up drawings that show location of work.
- 8. Submit letter(s) with associated product data signed by Manufacturer certifying that submitted products are suitable for application on the surfaces to be resurfaced and for the service conditions.

1.05 DELIVERY AND STORAGE

- A. Materials shall be stored in accordance with Manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.
- B. Store all materials only in area or areas designated by the Engineer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of materials-related debris before authorized disposal, to these areas. All materials are to be stored on pallets or similar storage/handling skids off the ground in sheltered areas in which the temperature is maintained between 50°F and 90°F.
- C. Mix all resurfacing materials in an enclosed mixing area designated by the Engineer. This enclosed area must protect the mixing operation and materials from direct sunlight, inclement weather, freezing, or other means of damage or contamination. Protect all other concrete and metallic surfaces and finishes from any spillage of material(s) within the mixing area.
- D. Do not use floor drains, dikes or storm drains for disposal of resurfacing system materials.
- E. The Contractor shall take all precautions and implement all measures necessary to avert potential hazards associated with the resurfacing system materials as described on the pertinent Material Safety Data Sheets or container labels.
- F. Deliver all materials to the job site in their original, unopened containers. Each container shall bear the Manufacturer's name and label.
 - 1. Labels on all material containers must show the following information:
 - a. Name or title of product.
 - b. Federal Specification Number if applicable.
 - c. Manufacturer's batch number and date of manufacture.
 - d. Manufacturer's name.
 - e. Generic type of material.
 - f. Application and mixing instructions.
 - g. Hazardous material identification label.
 - h. Shelf life date.
 - i. Storage requirements.
- G. All containers shall be clearly marked indicating any personnel safety hazards associated with the use of or exposure to the materials.

- H. All materials shall be handled and stored to prevent damage or loss of label.
- I. Resurfacing material storage and mixing areas shall be designated by the Engineer.
- J. Do not use or retain contaminated, outdated, prematurely opened, diluted materials, or materials which have exceeded their shelf life.
- 1.06 COORDINATION OF WORK
 - A. Work Areas. The work areas on the job site will be designated by the Engineer. The Contractor's personnel shall not be permitted in any area other than those expressly designated by the Engineer.
 - B. Coordination. The contractor shall coordinate with the Engineer regarding availability of work areas, completion times, safety, access and other factors which can impact plant operations.
- 1.07 SAFETY
 - A. The Contractor's work forces should comply with the provisions outlined in the following documents:
 - 1. SSPC-PA-3"A Guide to Safety in Paint Application"
 - 2. NACE Pub...... "A Manual for Painter Safety"
 - B. The Contractor shall provide personnel with all safety equipment necessary to protect them during any phase of the work. This shall include, but not be limited to safety glasses, goggles, earplugs, hard hats, steel toed work shoes, appropriate personal protective clothing, gloves, and plant approved escape respirators (where required).
 - C. No work shall be performed until the appropriate Work Requests and lock-outs are approved by the Engineer. The Work Request system provides a mechanism to advise plant staff of a contractor's work activities. The Lockout system is a safety procedure to prevent unintended equipment activation.
 - D. Keep any flammable materials such as cleaning solvents, thinners, or resurfacing materials away from open flames, sparks or temperatures higher than 150°F. Drums containing flammable materials will be grounded. No solvent in any quantity shall be allowed inside containment enclosures or permitted confined spaces at any time during resurfacing work.
 - E. Power tools are to be in good working order to avoid open sparking. No spark producing tools shall be utilized in restricted areas as indicated herein.
 - F. The Contractor shall fireproof all work areas by maintaining a clean work area and having Underwriter's Laboratories approved fire extinguishers on-hand. The Contractor shall furnish these fire extinguishers.
 - G. Workers doing abrasive blasting operations shall wear a fresh air supplied protective helmet and hood and personal protective clothing acceptable to industry standards and all government regulations.
- H. Dispose of rags used for wiping up resurfacing materials, solvents, and thinners by drenching them with water and placing in a metal container with a tight fitting metal cover. Complete this disposal process at the end of each day. Final disposal of these materials is the Contractor's responsibility.
- I. Matches, smoking, flames, or sparks resulting from any source including welding, must be remote from the work area during coating work.
- PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials specified are those that have been evaluated for the specific service. Products of the Carboline Company and Raven are listed to establish a standard of quality. Equivalent materials of other manufacturer's may be submitted for approval of the Engineer.
- B. Requests for substitution shall include manufacturer's literature for each product giving name, product number, and generic type, descriptive information, solids by volume, recommended dry film thickness and certified lab test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service.
- 2.02 MATERIALS
 - A. Epoxy Lining System
 - 1. The following products, or prior approved equal, shall be used:
 - a. Re-Surfacer/ Cementitious Repair:
 - (i) Raven 755
 - (ii) Sauereisen: No. F120 Underlayment and Repair Mortar
 - b. Lining:
 - (i) Raven 405
 - (ii) Sauereisen: SewerGard 210
 - (iii) Warren Environmental 301-14
 - B. Abrasive Blast Media. If dry or wet abrasive blast cleaning is the selected method of surface preparation, provide slag grit of a sieve size, gradation, and quality necessary to produce the degree of cleanliness and surface profile required herein.

2.03 EPOXY COATING

A. The epoxy coating system will consist of a 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select filters to minimize permeability and provide sag resistance acceptable to these specifications:

Product Type:	Amine Cured Epoxy
Solids Content (vol %):	
Mix Ratio:	
Compressive Strength (minimum), psi:	

Tensile Strength:	
Tensile Elongation (minimum), %:	1.50
Flexural Modulus, psi:	
Hardness, Type D:	
Bond Strength - Concrete:	>Tensile Strength of Concrete
Chemical Resistance:	N/A
Severe Municipal Sewer:	All Types of Service
Successful Pass:	Sanitation District of L.A. County
	Coating Evaluation Study
	or SSPWC 210.2.3.3

PART 3 EXECUTION

3.01 GENERAL

- A. Hoisting, Scaffolding, Staging, and Planking
 - 1. Provide, set-up, and maintain all required hoists, scaffolds, and staging and planking, and perform all access related hoisting work required to complete the work of this section as indicated and specified.
 - 2. Scaffolds shall have solid backs and floors to prevent dropping materials from there to the floors or ground below.

B. Environmental Requirements

- 1. Comply with the Manufacturer's recommendations as to environmental conditions under which resurfacing system materials can be applied.
- 2. Do not apply resurfacing system materials when dust is in work site.
- 3. The Contractor shall provide all temporary lighting during the work.
- C. Protection
 - 1. Cover or otherwise protect finish work or other surfaces not being resurfaced.
 - 2. Erect and maintain protective tarps, enclosures and/or maskings to contain debris (such as dust or airborne particles resulting from surface preparation) generated during any and all work activities. This includes, but is not limited to, the use of dust/ debris collection apparatus as required.
- D. Initial Inspection of Surfaces to be Coated.
 - 1. It is the responsibility of the Contractor to inspect and report unacceptable concrete substrate surface conditions to the Engineer prior to the commencement of surface preparation activities. Unacceptable surface conditions are defined as the presence of cracked surfaces or concrete deteriorated to a depth of greater than 1" or otherwise unable to withstand surface preparation as specified herein.
- E. Thinners and Solvents
 - 1. The Contractor shall use only solvents and thinners as recommended by the Manufacturer.

3.02 SURFACE PREPARATION REQUIREMENTS

A. General

- 1. All specified surface preparation shall be performed in accordance with the latest version of the SSPC, NACE, ICRI and other standards referenced in this section.
- 2. Allow new concrete to cure a minimum of 28 days. Verify moisture limits are in accordance with manufacturer's instructions using ASTM D 4263 and ASTM F1869.
- 3. Oil and grease shall be removed before mechanical cleaning is started via an alkaline-based emulsifying detergent as recommended by the resurfacing material manufacturer. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants that might interfere with the adhesion of the resurfacing materials.
- 4. Concrete surfaces shall be abrasive blasted to remove all laitance from release agents, curing compounds sealers and other contaminants and to produce a minimum surface profile of ICRI CSP 5. This preparation will be followed by vacuum cleaning to remove all dust, dirt or friable substances leaving clean, dust free surfaces for resurfacing. The air used for blast cleaning shall be free of oil and moisture to not cause contamination of the surfaces to be resurfaced.
- 5. Clean cloths and clean fluids shall be used in solvent cleaning.
- 6. Cleaning and resurfacing shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly resurfaced areas.
- B. Abrasive Blast Cleaning
- C. Used or spent blast abrasive shall not be reused on work covered by this section.
- D. The compressed air used for blast cleaning will be filtered free of condensed water or oil. Moisture traps will be cleaned at least once every four hours or more frequently as is appropriate.
- E. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. Oil separators shall be cleaned at least once every four hours or more frequently as is appropriate.
- F. A paper blotter test shall be performed by the Contractor when requested by the Engineer or the Engineer's representative to determine if the air is sufficiently free of oil and moisture.
- G. Regulators, gauges, filters, and separators will be in good working order for all of the compressor air lines to blasting nozzles at all times during this work.
- H. An air dryer or drying unit shall be installed which dries the compressed air prior to blast connections. This dryer shall be used and maintained for the duration of surface preparation work.
- I. The quality, volume, and velocity of life support and ventilation air used during surface preparation shall be in accordance with applicable safety standards and as required to ensure adequate visibility and proper dissipation of volatiles without impacting the prepared surface or the health of the public or personnel working for the Contractor, Subcontractors, Engineer, Engineer's Representatives, or anyone who may be affected by on-site maintenance coating work activities.

- J. The abrasive blast nozzles used shall be the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and the necessary volume to obtain the required blast cleaning production rates and specified degree of cleanliness.
- K. The Contractor must provide adequate ventilation for airborne particulate evacuation and lighting (meeting all pertinent safety standards) to optimize visibility for both blast cleaning and observation of the substrate during surface preparation work.
- L. All phases of surface preparation work specified herein must be inspected by the Engineer before the Contractor proceeds with the subsequent phase of surface preparation.
- M. If, between final surface preparation work and coating application, contamination of the prepared and cleaned substrate occurs, or if the prepared steel's appearance darkens or changes color, reblasting will be required until the specified degree of cleanliness is established.

3.03 APPLICATION REQUIREMENTS

- A. General
 - 1. Areas not to be resurfaced shall be masked using duct tape or other protection materials to prevent these surfaces from being resurfaced.
 - 2. Ensure straight even termination of resurfacing/topcoat materials on wall edges and flush with embedded steel.
 - 3. The Contractor must follow the minimum and maximum recoat limitation times and related temperature range restrictions between successive lifts for all products specified herein per Manufacturer's stated requirements.
 - 4. All equipment and procedures used for resurfacing system application shall be as recommended by the Manufacturer.
 - 5. Unless specified elsewhere herein, the Contractor shall comply with the Manufacturer's most recent written instructions with respect to the following:
 - a. Mixing of All Materials.
 - b. Protection and Handling of All Materials
 - c. Recoat Limitation and Cure Times.
 - d. Minimum Ambient and Substrate Temperatures, Substrate's Degree of Dryness, Relative Humidity, and Dew Point of Air.
 - e. Application.
 - f. Final Curing.
 - g. Use of Proper Application Equipment.
 - 6. Curing of Lining System:
 - a. The applied lining system shall be protected from damage during curing and shall be cured as recommended by the Manufacturer. Ambient conditions shall be controlled by the Contractor during curing to ensure the minimum air temperature and minimum relative humidity as required by the Manufacturer is maintained.
- B. Chemical Resistant Lining
 - 1. General Note: The Contractor is advised that with all thick-film, quick curing materials applied to concrete surfaces, outgassing of the concrete can occur.

Possible remedies include applying materials when the temperature of the concrete surfaces are descending, or applying a thin (1/8") layer of the specified surfacing material. Other remedies may exist, and may be submitted for the Engineer's approval.

- 2. Apply surfacer at a nominal 1/16" to fill all voids, bugholes and other surface imperfections and to achieve a uniform surface.
- 3. Apply epoxy liner to all surfaces scheduled to be coated at a nominal thickness of 125 mils. Application shall be either by trowel or spray. If spray-applied, material shall be finish-troweled to a hard, dense film.
- C. Safety and Ventilation Requirements
 - 1. Requirements for safety and ventilation shall be in accordance with SSPC Paint Application Guide No. 3.

3.04 FIELD QUALITY CONTROL INSPECTION AND TESTING

- A. Inspection by the Engineer or others does not limit the Contractor's responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.
- B. Perform the quality control procedures listed below in conjunction with the requirements of this Section.
 - 1. Inspect all materials upon receipt to ensure that all are supplied by the Manufacturer.
 - 2. Provide specified storage conditions for the resurfacing system materials, solvents, and abrasives.
 - 3. Inspect and record findings for the degree of cleanliness of substrates using. The pH of the concrete substrate will be measured using pH indicating papers. pH testing is to be performed once every 50 sq. ft. Acceptable pH values shall be between 9.0 and 11.0 as measured by a full-range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH.
 - 4. Inspect and record substrate profile (anchor pattern). Surfaces shall be abraded, as a minimum, equal to the roughness of 40 grit sand paper.
 - 5. Measure and record ambient air temperature once every two hours of each shift using a thermometer and measure and record substrate temperature once every two hours using a surface thermometer.
 - 6. Measure and record relative humidity every two hours of each shift using a sling psychrometer in accordance with ASTM E337.
 - 7. Provide correct mixing of resurfacing materials in accordance with the Manufacturer's instructions.
 - 8. Inspect and record that the "pot life" of resurfacing materials are not exceeded during installation.
 - 9. Verify curing of the resurfacing materials in accordance with the Manufacturer's instructions.

- 10. Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE SP0188-90 to verify a pinhole-free surface. Voltage shall be set at 11,000 volts. Areas which do not pass the spark detection test shall be corrected at no cost to the Owner and rechecked. High voltage spark detection shall be conducted on the chemical resistant mortar before the installation of the gel coat.
- 11. Upon completion of the lining system installation the lined area shall be cleaned and prepared to permit close visual inspection by the Engineer or the Engineer's Representative. Any and all deficiencies or defective work (not in compliance with this section or related sections) will be marked for repair or removal/replacement by the Contractor at no additional cost to the Owner.

3.05 ACCEPTANCE CRITERIA

- A. Acceptance Criteria for Surface Preparation Work
 - 1. All surfaces shall be prepared in accordance with the specification and referenced standards therein.
- B. Acceptance Criteria for Coating System Application Work
 - 1. Acceptable coating work will be based upon the following:
 - a. No pock-marks, trowel marks, depressions, unconsolidated areas, waviness or ridges, pinholes or holidays in either size or frequency.
 - b. No intercoat bond failures between lifts.
 - c. Proper curing of coatings.
 - 2. Resurfaced areas shall pitch to drains.
 - 3. There shall be no areas that puddle when flood tested.
 - 4. The Engineer or Engineer's Representative shall, at their discretion, inspect the following:
 - a. Profile and degree of cleanliness of substrate.
 - b. Thickness of materials/coverage rate confirmation.
 - c. Ambient temperature and humidity requirements and substrate temperature.
 - d. Curing and recoat times.
 - e. Proper curing of the resurfacing materials.
 - 5. Rework required on any holidays or any other inadequacies found by the Engineer or the Engineer's representative in the quality of the coating work shall be marked. Such areas shall be recleaned and reworked by the Contractor according to these specifications and the manufacturer's recommendations at no additional cost to the Owner.
 - 6. The Contractor is responsible for keeping the Engineer informed of all progress so that inspection for quality can be achieved.
 - 7. The Contractor is ultimately responsible for the quality performance of the applied materials and workmanship. Inspections by the Engineer or the Engineer's Representative do not limit this responsibility.

3.06 FINAL INSPECTION

A. Perform a final inspection to determine whether the resurfacing system work meets the requirements of the specifications. The Engineer and the Engineer's Representative will conduct final inspection with the Contractor.

3.07 CLEANUP

A. Upon completion of work, the Contractor shall remove surplus materials, equipment, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any work-related damage. The surrounding surface areas including roadways and all other surfaces shall be restored to their pre-project condition.

END OF SECTION

SECTION 11062

PUMPING EQUIPMENT: NON-CLOG CENTRIFUGAL

PART 1 - GENERAL

1.1 SCOPE SUMMARY

- A. This section includes the Work necessary to furnish and install submersible non-clog centrifugal pumps in the lift stations and as further specified in the data sheet supplements hereinafter to make a complete system as shown on the Drawings. The elbow, guide rails, bracket, access hatch, and safety-cover will be provided for all pumps.
- B. Unit Responsibility:
 - 1. The Work requires that all equipment be complete with all accessories and appurtenances be the end product of one responsible system manufacturer or responsible system supplier.
 - 2. The CONTRACTOR shall obtain the system from the responsible supplier of the equipment. The supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features, and functions.
- C. Naming a manufacturer in PART 2- PRODUCTS does not relieve the manufacture from fully complying with all the requirements of the Contract Documents. The Contract Documents represent the minimum acceptable standards. Equipment must fully comply with all the requirements of the specifications and construction plans.

1.2 RELATED WORK

- A. Related Sections include, but are not necessarily limited, to:
 - 1. Section A, B, and C Contract Documents, Special Provisions, and General Provisions.
 - 2. Division 1 General Requirements
 - a. Section 01150- Measurement and Payment
 - b. Section 01330- Submittals
 - c. Section 01600 Material and Equipment
 - d. Section 01640 Contractor's Field Services
 - e. Section 01650 Facility Startup and Commissioning Services
 - f. Section 01740 Warranties
 - g. Section 01830 Operation and Maintenance Data
 - 3. Section 09900 Painting
 - 4. Division 16 Electrical

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

- 1. American National Standards Institute/American Bearing Manufacturers' Association (ANSI/ABMA): 9 and 11, Load Ratings and Fatigue Life for Ball Bearings and Roller Bearings.
- 2. American National Standards Institute/American Gear Manufacturers Association (ANSI/AGMA):
 - a. 2000-A88, Gear Classification and Inspection Handbook Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
 - b. 6034-B92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
 - c. 9005-D94, Industrial Gear Lubrication.
- 3. American Welding Society (AWS):
 - a. B2.1, Standard for Welding Procedure and Performance Qualification.
 - b. D1.1, Structural Welding Code Steel.
 - c. QC 1, Standard for AWS Certification of Welding Inspectors.
- 4. ASTM International (ASTM):
 - a. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - b. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
 - c. D3917, Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes.
- 5. National Electric Code (NEC).
- 6. National Electrical Manufacturers Association (NEMA).
- 7. National Fire Protection Association (NFPA) 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
- 1.4 DEFINITIONS
 - A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.
- 1.5 QUALIFICATIONS
 - A. The Pumping Units specified shall be the products of reputable manufacturers who have been regularly engaged in the design, manufacture and furnishing of Wastewater Submersible Pumping Equipment for at least ten (10) years. The manufacturer shall have installed similar pumps, performing similar duty, for at least three (3) other installations in Texas. Each such installation shall have performed satisfactorily for at least five (5) years and be still in operation. The manufacturer shall provide references and their contact details to verify these successful installations.
 - B. Pump(s) shall be engineered and manufactured under the certification of ISO-9001.
 - C. All manufacturer parts and components shall be engineered for long, continuous and uninterrupted service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts.
 - D. Where like items are incorporated into equipment systems (i.e. motors, push buttons, etc.) such items must be identical to achieve standardization for appearance, operation, maintenance, spare parts, and service. Corresponding parts of multiple units shall be interchangeable.

- E. All stages of the manufacturing process shall be carefully inspected at the factory by factory inspectors who shall use whatever means necessary to assure the proper fit of all field connections and compliance with all material and fabrication requirements of the specifications.
- F. The pump, mechanical control panel, SCADA/PLC panel, 24V DC UPS, and pump junction boxes shall be factory wired and assembled. Assembly and wiring shall be to the point where the only field interconnections to numbered terminal blocks are required.
- G. If equipment is offered that differs from the manufacturer listed as "A.1" in Paragraph 2.2, equipment will be acceptable only under the following conditions. Any layout revisions and construction of the structure, piping, appurtenance equipment, electrical work, etc required to accommodate equipment shall be made at no additional cost to the Owner.

1.6 SUBMITTALS

- A. General:
 - 1. Provide Shop Drawings, samples, administrative, quality control, and contract closeout submittals in accordance with the requirements of Section 01300, SUBMITTALS, Section 01830, OPERATIONS AND MAINTENANCE DATA, Section 01640, CONTRACTOR'S FIELD SERVICES, and as listed below.
- B. Shop Drawings:
 - 1. Make, model, weight, and horsepower of each equipment assembly.
 - 2. Complete catalog information, descriptive literature, Specifications, identification of materials of construction.
 - 3. Performance Data Showing Compliance with Specification Requirements including: Pump curves showing head, flow, horsepower demand, and net positive suction head requirement over the entire operating range.
 - 4. Detailed Mechanical and Electrical Drawings showing the equipment fabrications and interface with other items include: Dimensions, sizes and locations of connections to other work, and weights of equipment associated therewith.
 - 5. Outside utility requirements such as air, water, power, drain, etc., for each component.
 - 6. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.
 - 7. Power and control wiring diagrams, including terminals and numbers.
 - 8. Factory finish system including epoxy coating system for cast iron and steel components. Include manufacturer's descriptive technical catalog literature and specifications, and hazardous communication data sheets.
 - 9. Instrumentation and control submittals in accordance with Division 13-Special Construction.
- C. Provide Quality Control Submittals as Follows:
 - 1. Quality Control Submittals as in accordance with Section 01640 CONTRACTOR'S FIELD SERVICES.

- 2. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
- 3. Manufacturer's Certificate of Proper Installation.
- 4. Manufacturer's Training Program.
- 5. Certificate of Successful Equipment Testing.
- 6. Certificate of Successful Equipment System, Subsystem or Component, Start Up Testing including Functional and Performance Tests.
- 7. Certificate of qualification of CONTRACTOR's representative.

1.7 OPERATION AND MAINTENTANCE MANUALS

A. Provide manufacturer's Operation and Maintenance Manual(s) (O&M) and Maintenance Summary Form(s) in accordance with OPERATION AND MAINTENANCE DATA in Section 01830.

1.8 WARRANTY

- A. Equipment warranty requirements shall comply with Section 01740, WARRANTIES.
- B. Submit warranty from the equipment manufacturer clearly stipulating that manufacturer's warranty period shall be for two (2) years commencing at final acceptance by the Owner.
- 1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING
 - A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
 - B. All equipment and parts must be properly protected against any damage during shipment. The Contractor shall store equipment in accordance with manufacturer's recommendations.
 - C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
 - D. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.
 - E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
 - F. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of storage while waiting completion of storage while waiting completion of installation and start-up by the application of Exxon Rust-Ban No. 392, or equal treatment.
 - G. Product, delivery, storage, and handling should comply with Section 01600, MATERIAL AND EQUIPMENT

1.10 CONTRACTOR'S CERTIFICATES

A. Provide contractor's certificate(s) in accordance with Paragraph 1.07 CONTRACTOR'S CERTIFICATES OF COMPLIANCE in Section 01640.

1.11 SPARE PARTS

- A. Furnish, tag, and manufacturer recommended list of spare parts including:
 - 1. Basic Repair Kit to include orings, seals and bearings.
- B. Any special tools, required to dismantle the unit, shall be shipped in a wooden box and shall be protected from damage, moisture, and dirt accumulation.
- C. Parts shall be protected as for an extended storage period. The box shall be heavily constructed with hinged cover, hasp and lock, and designed as a permanent storage enclosure for the spare parts.
- D. The spare parts shall, if possible, be enclosed within an airtight membrane. Spare parts supplied in matched sets, such as drive belts, shall be wrapped, bound, or labeled to indicate a set.
- E. Parts shall be labeled clearly, along with manufacturer's part numbers.

PART 2 - PRODUCTS

- 2.1 GENERAL
 - A. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, and appurtenances such as, but not limited to, couplings, guards and gages.
 - B. All necessary foundation bolts, nuts and washers shall be furnished and shall be Type 316 stainless steel.
- 2.2 MANUFACTURERS
 - A. The following pump manufacturers are approved for this project:
 - 1. Flygt/Xylem Water Solutions USA, Inc.
 - 2. KSB
- 2.3 SERVICE CONDITIONS
 - A. Service conditions are as listed on the enclosed Equipment Data Sheets 11062A.
 - B. Equipment Environment Application Ratings: NEC, Class 1, Division 1, Group D.
- 2.4 SYSTEM PERFORMANCE REQUIREMENTS
 - A. The system performance requirements are as listed on the Equipment Data Sheet.
- 2.5 EQUIPMENT AND MATERIALS
 - A. General
 - 1. Major pump components shall be of gray cast iron, ASTM A-48 Class 35B, with smooth surfaces devoid of blowholes and other irregularities.
 - 2. Exposed nuts and bolts shall be AISI type 316 stainless steel or brass construction.

- 3. All surfaces, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- 4. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
 - a. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.
- B. Impeller (Option A)
 - 1. The impeller shall be hard iron ASTM A-532 (Alloy III A) 25% chrome cast iron dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design.
 - 2. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a machined spiral groove located on the stationary insert ring maintaining an unobstructed leading edge.
 - 3. The impeller shall be induction hardened to Rc 45, screw shaped leading edges and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.
 - 4. Impellers shall be locked to the shaft and shall be coated with alkyd resin primer.
 - 5. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw.
 - 6. A replaceable insert ring shall be hard iron ASTM A-532 (Alloy III A) 25% chrome cast iron having an integral machined spiral shaped groove shall be installed in the pump volute. The clearance between the insert ring and the impeller shall be adjustable to provide effective sealing between the multi-vane semi-open impeller and the volute housing.
- C. Impeller (Option B)
 - 1. The impeller shall be made of ASTM A 48 Class 35B Cast Iron dynamically balanced, single vane, multi-vane, vortex design- all passing a minimum 3" non-compressible solid.
 - 2. Impellers shall be set on tapered shaft held by a bolt and a washer.
 - 3. The impeller to volute clearance shall be adjustable by means of adjusting the impeller and casting wearing rings.
 - 4. An ASTM A 48 Class 35B Class Cast Iron casing wear ring.
 - 5. The impeller can utilize a 420 Stainless Steel wearing ring. The impeller wearing ring shall be replaceable.
- D. Volute
 - 1. Pump volutes shall be single piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller.
 - 2. Minimum inlet and discharge size shall be as indicated herein.

- E. Motor
 - 1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, water tight chamber.
 - 2. Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve. Motor requirements shall be as specified on the enclosed Pump Data Sheets.
 - 3. The submersible motor shall be FM or UL Listed for Class I, Division 1, Groups C and D explosion-proof hazardous locations.
 - 4. Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NEC specifications for pump motors. Cable shall be of sufficient length to reach junction boxes without strain or splicing.
 - 5. Provide thermal sensors within each pump motor. Also, provide conductors and watertight cable between sensors and junction box.
 - 6. Provide casing leakage sensors within each pump motor. Also, provide conductors and watertight cable between sensors and junction box.
 - 7. Provide each pump with 50 feet (minimum) of heavy-duty waterproof cable suitable for submerged service. The pump supplier shall be responsible for coordinating with the CONTRACTOR to provide the proper length of cable.
 - 8. The stator windings shall be insulated with moisture-resistant Class H insulation for 180 degrees C.
 - 9. The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%.
 - 10. The motor shall be designed for continuous duty while handling pumped media of up to 104 degrees F.
 - 11. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of fastening devices used to hold or locate the stator and that penetrate the stator housing are not acceptable.
 - 12. The motor service factor shall be 1.15. The motor shall have a voltage tolerance of +/-10%.
 - 13. The motor shall be designed for continuous duty capable of fifteen (15) evenly spaced starts per hour.
 - 14. The motor shall be designed for a continuous operation in up to a 40 degree C ambient and shall have a NEMA Class B maximum operating temperature rise of 80 degrees C.
 - 15. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.
 - 16. Motor shaft shall be one-piece, extending through the pump and motor. Extension couplings shall not be acceptable. Shaft shall be constructed of 431stainless steel. Shaft sleeves shall not be acceptable.
- F. Cable Entry Seal
 - 1. The power cable entry seal design shall preclude specific torque requirements to insure a watertight seal and shall allow simple field changing of power without affecting pump or motor warranty.

- 2. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.
- 3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices.
- 4. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber.
- 5. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
- 6. A separate junction chamber shall be provided inside the pump for connection of power cables to stator leads. The chamber shall be sealed by a nonmetallic terminal board bolted to a machined surfaced and utilizing an O-ring to obtain a watertight seal.
- G. Cooling System
 - 1. The Pump shall be provided with an integral closed-loop cooling system with cooling jacket only if required by the pump manufacturer to meet the minimum submergence and wet well operating levels shown on the plans.
 - 2. The coolant shall consist of a non-poisonous and an environment friendly media such as Monopropylene-Glycol.
 - 3. The main cooling area shall be the seal housing cover.
 - 4. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer.
- H. Mechanical Seal
 - 1. Pumps shall be provided with a mechanical seal system consisting of two totally independent seal assemblies operating in an oil chamber between the pump volute and motor chamber for seal lubrication and cooling.
 - 2. The lower seal shall act as the primary unit to prevent entry of pumped liquid to the oil chamber and shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring.
 - 3. The upper seal shall act as a secondary unit to prevent pumped liquid or oil from entering the stator housing and shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring.
 - 4. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance
 - 5. Mounting of the lower seal on the impeller hub is not acceptable
 - 6. The seal system shall allow continuous pump operation with the motor exterior totally dry.
 - 7. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing.
- I. Bearings
 - 1. The motor bearings shall be permanently grease lubricated with a B-10 design life of 50,000 hours at the design point of the pump.

- 2. The upper bearing shall be two row angular contact ball bearing.
- 3. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces.
- J. Pump protection devices
 - 1. The pump manufacturer shall provide a pump monitoring unit which shall be mounted in the control panel or mounted on a dead front panel or swing out door and shall be wired to activate an alarm.
 - 2. Pump protective devices
 - a. Thermal switches in the stator windings which shall open at 125°C (260°F) to stop the motor and activate an alarm.
 - b. A Float leakage sensor shall be placed in the stator housing to detect water intrusion into the chamber. When activated, the sensor will stop the motor and activate an alarm.
- K. Accessories
 - 1. The pump manufacturer shall furnish all station hardware and accessories for use with the pumps furnished or for any future requirements or revisions as may be indicated in the Plans or other sections of the Contract Specifications.
 - 2. All items inside the wet well shall be stainless steel or aluminum as indicated below.
 - 3. To insure compatibility, all access covers in structures containing submersible pumps shall be provided by the supplier of the submersible pumps. See specification for access cover requirements.
- L. Testing
 - A certified factory performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, 2B, requirements. Pumps less than 13HP tolerance level <13kW. Tests shall be sufficient to determine the curves of flow/head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition.
 - 2. Results of the performance tests shall be submitted to the Owner for approval before final shipment.

2.6 MECHANICAL ACCESSORIES:

- A. General:
 - The Pump Manufacturer shall furnish and be responsible for coordinating proper fit and suitability of all station hardware and accessories for the use with the pumps furnished or for any future requirements or revisions as may be indicated on the Drawings or other sections of the Contract Specifications. All items furnished shall be guaranteed to the Owner as being suitable for the intended use and shall be warranted against defective workmanship, materials and excessive corrosion for a period of two years after startup and beneficial use by the Owner.

- B. Access Covers:
 - 1. To ensure compatibility the supplier of the submersible pumps shall supply all access covers in structures containing submersible pumps as shown on the Drawings.
 - 2. Quantity and sizes are stated on the plans.
 - 3. Access covers shall be provided by one of the following manufacturers:
 - a. EJ
 - b. USF Fabrication
 - c. Halladay Products
 - d. Or equivalent.
 - 4. Retrofit hatches on Lift Station 9 and Lift Station 10 shall be secured to the existing concrete wet well lid with ½" diameter, Hilti HIT-Z anchor rods embedded 6" into the existing concrete. Adhesive anchors shall be installed per Specification 05051: Anchor Bolts. Minimum number of anchors per retrofit hatch shall be:
 - a) 3'-6" x 5'-0" hatches: 10 anchors each
 - b) 18" x 18" hatch: 4 anchors
 - 5. Material shall be 6061-T6 aluminum for bars, angles and extrusions. 1/4" diamond plate shall be 5086 aluminum. Exterior of frame which comes into contact with concrete shall have one coat black bituminous paint.
 - 6. Non-Traffic Pedestrian Rated Hatches: Material- Aluminum with a minimum live load of 300-lbs./sq. ft. Deflection shall not exceed 1/150th of the span.
 - 7. Vehicular Traffic Load Rated Hatches: Material- Ductile Iron with minimum AASHTO M 306 loading.
 - 8. Covers shall be supplied with a heavy-duty stainless steel pneu-spring for ease of operating when opening cover. Covers shall be counterbalanced so that one person can easily open the hatch door. Spring design shall accommodate ease of maintenance.
 - 9. Each door shall be equipped with a hold-open arm. Door shall lock open in the 90degree position automatically, or by use of a hold-open arm. The hold-open arm shall be fastened to the frame with a $\frac{1}{2}$ grade 316 stainless steel bolt.
 - 10. Angle frame shall be of extruded aluminum with a continuous 1-1/2" anchor flange. Angle frame shall be a minimum of $\frac{1}{4}$ " thick.
 - 11. Cover hinges shall be of heavy-duty design. Material shall be grade 316 stainless steel. Each hinge shall have a grade 16 stainless steel 3/8" diameter hinge pin. Hinge shall be fastened to angle and diamond plate with grade 316 stainless steel bolts and ny-lock nuts.
 - 12. Each hatch shall be supplied with a grade 316 stainless steel slam lock with keyway protected by a threaded removable plug. Plug shall be flush with the top of the ¼" diamond plate. Slam lock shall be fastened with grade 316 stainless steel bolts and washers.
 - 13. Each hatch shall be equipped with an aluminum lift handle. The lift handle shall be flush with the top of the $\frac{1}{4}$ " diamond plate.
- C. SAFE-HATCH:

- 1. All access covers shall have a two-hinged "SAFE-HATCH" safety grate designed to combine covering of the opening, fall through protection per OSHA standard 1910.23 and controlled confined space entry per OSHA standard 1910.146.
- 2. The grating shall be designed to withstand a minimum live load of 300 pounds per square foot. Deflection shall not exceed 1/150th of the span.
- 3. Doors cannot be closed unless the fall through protection has been put back in place
- 4. Grate openings shall be 5" x 5" or 3" x 5", which will allow for visual inspections, limited maintenance and float adjustment while safety grate is left in place.
- 5. Quality materials provide superior corrosion resistance (designed to withstand the harsh sewer environment)
- 6. Open grates create a physical barrier around the pit, protecting passing pedestrians
- 7. Grates shall be "Safety Orange" in color for a visual awareness of the hazard.
- D. Guide Rail Brackets:
 - 1. Dual rail upper guide rail brackets shall be provided by the pump supplier for each pump. Each bracket shall have two 3/16" hooks for supporting pump power cables and lifting assemblies. The upper guide rail bracket shall be constructed of 316 stainless steel.
 - 2. Dual rail intermediate guide rail brackets shall be provided by the pump supplier for guide rails which exceed 20 feet in length. Intermediate guide rail brackets shall be located at each 20' increment of guide rail or at mid-point of guide rail span. The intermediate guide rail bracket shall be constructed of 316 stainless steel.
- E. Power Cable Supports:
 - 1. A stainless steel or non-metallic cable grip shall be provided for each pump power and pilot cable. The grip shall have a loop on one end, which will hang from a hook provided on the upper guide bar bracket.
 - 2. Mounting bracket support rack with hooks constructed of 316 stainless steel shall be provided for supporting the power cables, lifting cable/chain assembly and level controls. A mounting support rack with hooks shall be provided for each pump.
- F. Pump Lifting Assembly:
 - 1. A stainless steel wire, of diameter matching weight of lifting chain required, connected to a short length (approximately ten links long) of high tensile strength proof-tested 316 stainless steel chain of required capacity, connected to the lifting eye or lifting bail of the submersible pump. Total length of assembly shall reach the top of the station plus five feet.
 - 2. A forged "grip-eye" of wrought alloy steel, shall be provided to connect to the end of the lifting cable or chain of the pump lifting device. One "grip eye" shall be provided per lift station.
- G. Discharge Connection and Guide Rail System
 - Pump supplier shall provide a discharge connection and guide rail system for each pump. Discharge connection shall be ASTM A 48 Class 35 B construction (minimum) with 125 lb. flanged connections.

2. Guide rail connection for the pump ("claw") to allow the pump to slide up/down the guide rails shall be provided for each pump. Bolting and hardware shall be of 316 stainless steel construction.

2.7 ELECTRICAL CONTROL PANEL

A. The Pump Manufacturer shall provide and be responsible for proper electrical protection and control operation. The Pump Supplier shall supply the pump control panel in order to assure unit responsibility for equipment selection, component compatibility, startup and operational checks and future service. Electrical equipment supplied must comply with all requirements of Division 16 Electrical and with the Electrical Drawings.

2.8 ACCESSORIES

- A. Lifting Lugs: Equipment weighing over 70-pounds.
- B. Anchor Bolts: Type 316 stainless steel sized by equipment manufacturer, ½-inch minimum diameter, and as specified in Section 05051, ANCHOR BOLTS
- C. Equipment Identification Plate: 16-gauge Type 316 stainless stell with 1/4 –inch diestamped equipment tag number securely mounted in a readily visible location.

2.9 SOURCE QUALITY CONTROL

A. Factory Test: Perform manufacturer's standard test on equipment. Submit results to Owner for review.

PART 3 - EXECUTION

3.1 GENERAL

A. Packaged Equipment: When any system is provided as prepackaged equipment, coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer including safety interlocks.

3.2 INSTALLATION

- A. Installation of the pumps shall be in strict accordance with the manufacturer's instructions and recommendations.
- B. The locations of the discharge piping are shown on the construction drawings.
- C. The location of the pumps, access covers, and discharge connection are approximate. The precise placement and alignment of anchor bolts, discharge assembly, guide rails, access cover and associated connections shall be in accordance with the supplemental construction details provided by the pump manufacturer. The manufacturer shall check alignment during start up field testing. Improper alignment shall be corrected by the Contractor prior to continuation of testing.

3.3 STARTUP AND FIELD TESTING

- A. After the pumps have been completely installed and wired, the Contractor shall remove the pumps to the wet pit top deck and an authorized representative of the pump manufacturer shall inspect each pump for proper installation.
 - 1. Megger stator and power cable

- 2. Measure and record stator and power cable resistance
- 3. Check for proper rotation
- 4. Check power supply voltage
- 5. Measure Motor no load current
- 6. Check level control operation and sequence
- 7. Review recommended operation and maintenance procedure
- 8. Review warranty with Owner's personnel
- B. After initial inspection, the Contractor shall lower the pumps into place in the wet pit and provide water for an initial operation check. The manufacturer's service representative shall supervise lowering and connection of the pumps to the discharge connection confirming proper guide rail and discharge connection alignment. The service representative shall then perform an initial operation check of each pump including:
 - 1. Motor current in each phase
 - 2. Supply voltage with one, two and three pumps running
 - 3. Vibration
 - 4. Discharge connection seating
- C. On completion of initial inspection and operational checks, the pump manufacturer shall furnish the Engineer with a written report of the findings and data determined with regard to the pumps, motors, accessories, level control and electrical protection devices. The final report shall be signed by a manufactures authorized field representative. A copy of the report shall be included in the operation and maintenance manuals.

3.4 FIELD QUALITY CONTROL

- A. Provide Field Quality Control Tests as follows:
 - 1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Flow Output: Measured by plant instrumentation and storage volume.
 - 3. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

3.5 MANUFACTURERS' SERVICES

- A. Manufacturer's Services and Certificate of Compliance: Provide Manufacturer's Services and Manufacturer's Certificate of Compliance in conformance with the requirements of Section 01640, CONTRACTOR'S FIELD SERVICES. Manufacturer's representation shall provide supervision of equipment installations, field inspection of equipment before startup and the executed copies Manufacturers Services and Certificate of Compliance.
- B. Manufacturer's Representative: Present at site or classroom designated by the OWNER, for minimum person-days listed below (per lift station site), travel time excluded:
 - 1. Manufacturer's Assistance to the CONTRACTOR: Two (2) days and 1 trip.
 - 2. Manufacturer's Certificate of Proper Installation: Two (2) days and 1 trip.

3. Manufacturer's Training Program: One (1) days and 1 trip.

3.6 SUPPLEMENTS

- A. Supplements listed below, following "END OF SECTION," are part of this Specification.
 - 1. 11062A-01-Data Sheet- Lift Station Pumps.

PUMP DATA SHEET LIFT STATION 9

SUBMERSIBLE PUMPS DATA SHEET, 11062A-01

Tag Numbers: P-1, P-2, P-3 Pump Names: Submersible Pumps Nos. 1, 2, & 3 Manufacturer and Model Name: Flygt: NP 3231/675 or KSB: KRT K 200-403/804XNG-K

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Raw Wastewater Pumping Temperature (Fahrenheit): Normal: 68 Max: 104 Specific Gravity at 60 Degrees F: 1.0 Abrasive (Y/N): Y Largest diameter solid pump can pass (inches): 3 inches

PERFORMANCE REQUIREMENTS (One Pump Running)

Rated Point: 2650 gpm @ 112 feet Total Dynamic Head (TDH) Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): 70.0

DESIGN AND MATERIALS

Pump Type: Heavy-Duty Non-Clog (Y/N): Y Other: Submersible Volute Material: Cast Iron ASTM A48 Class 35B Pump Casing Material: Cast Iron ASTM A48 Class 35B Motor Housing Material: Cast Iron ASTM A48 Insert Ring (Y/N) Y Material: Hard Iron ASTM A-532, 25% Chrome Cast Iron Wear Ring Impeller (Y/N): N Material: Elastomers: Nitrile Rubber Fasteners: Stainless Steel Impeller: Type: Double-Shrouded Non-clog Material: Hard Iron ASTM A-532, 25% Chrome Cast Iron Shaft Material: 431 Stainless steel Base Elbow: Cast Iron ASTM A48 Class 35B Double Mechanical Seal: Yes Bearing Life (Hrs): min 50,000 hrs

DRIVE MOTOR

Horsepower: 100 Voltage: 240/480 Phase: 3 Enclosure: Submersible Classification: Class 1, Division 1, Group D FM Rated

OTHER FEATURES

Moisture Detection Switches (Y/N): Y Thermal Protection Embedded in Windings (Y/N): Y

PUMP DATA SHEET LIFT STATION 10

SUBMERSIBLE PUMPS DATA SHEET, 11062A-01

Tag Numbers: P-1, P-2 Pump Names: Submersible Pumps Nos. 1 & 2 Manufacturer and Model Name: Flygt: NP3135.095 MT or KSB: KRT E100-253/224XEG-S

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Raw Wastewater Pumping Temperature (Fahrenheit): Normal: 68 Max: 104 Specific Gravity at 60 Degrees F: 1.0 Abrasive (Y/N): Y Largest diameter solid pump can pass (inches): 3 inches

PERFORMANCE REQUIREMENTS (One Pump Running)

Rated Point: 850 gpm @ 50 feet Total Dynamic Head (TDH) Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): 70.0

DESIGN AND MATERIALS

Pump Type: Heavy-Duty Non-Clog (Y/N): Y Other: Submersible Volute Material: Cast Iron ASTM A48 Class 35B Pump Casing Material: Cast Iron ASTM A48 Class 35B Motor Housing Material: Cast Iron ASTM A48 Insert Ring (Y/N) Y Material: Hard Iron ASTM A-532, 25% Chrome Cast Iron Wear Ring Impeller (Y/N): N Material: Elastomers: Nitrile Rubber Fasteners: Stainless Steel Impeller: Type: N Impeller Non-Clog Material: Hard Iron ASTM A-532, 25% Chrome Cast Shaft Material: 431 Stainless Steel Base Elbow: Cast Iron ASTM A48 Class 35B Double Mechanical Seal: Yes Bearing Life (Hrs): min 50,000 hrs

DRIVE MOTOR

Horsepower: 30 max. Voltage: 240/480 Phase: 3 Enclosure: Submersible Classification: Class 1, Division 1, Group D FM Rated

OTHER FEATURES

Moisture Detection Switches (Y/N): Y Thermal Protection Embedded in Windings (Y/N): Y

END OF SECTION

SECTION 13120

PRECAST CONCRETE BUILDING PREFABRICATED

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. Contractor to furnish precast, post-tensioned concrete building. Building to be field erected on cast-in-place concrete foundation in accordance with Manufacturer's recommendations. Building to be provided by Manufacturer with all necessary openings as specified in conformance with Manufacturer's structural requirements.
 - B. Related Work:
 - 1. Section 01300 Submittals
 - 2. Division 2 Site Work
 - 3. Division 3 Concrete Work
 - 4. Section 09900 Painting
- 1.02 CODES, STANDARDS AND REFERENCES
 - A. ACI-318-14, "Building Code Requirements for Structural Concrete".
 - B. ASCE-7-10, "Minimum Design Loads for Buildings and Other Structures".
 - C. 2015 IBC, "2015 International Building Code".
 - D. PCI Design Handbook, Precast/Prestressed Concrete Institute.
 - E. UL 752, Standard for Safety for Bullet Resisting Equipment, Underwriters Laboratories Inc.
 - F. "Manual of Standard Practice", Concrete Reinforcing Institute.
 - G. ASTM, American Society for Testing and Materials:
 - 1. C150 Standard Specification for Type I and Type II Low Alkali Portland cement.
 - 2. C33 Standard Specification for Concrete Aggregates.
 - 3. A36 Standard Specification for Carbon Structural Steel.
 - 4. A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 6. A416 Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
 - 7. A1064 Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 8. A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

- 9. A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 10. A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- 1.03 QUALITY ASSURANCE
 - A. Building fabricator must have a minimum of 10 years experience manufacturing pre-cast concrete buildings.
 - B. Building fabricator must be a producer member of the National Precast Concrete Association (NPCA).
 - C. No alternate building designs to the pre-engineered specified building manufacturers will be allowed unless pre-approved by the Owner TEN (10) days prior to the bid date.
 - D. Acceptable Manufacturers:
 - 1. Lonestar Prestress Mfg., Inc., Houston, Texas
 - 2. Oldcastle Precast, Telford, Pennsylvania
- 1.04 DESIGN REQUIREMENTS
 - A. Dimensions: Per the Construction Drawings
 - B. Standard Design Loads:
 - 1. Wind Loading Min. 120 MPH (ASCE 7-10, Category III, Exposure C, Enclosed Building).
 - 2. Roof Live Load 60 PSF.
 - 3. Floor Live Load N/A.
 - 4. Seismic Design Category 'A', Seismic use Group I, Site Class "D", Seismic Importance Factor 1.25.
 - C. Roof: Roof panel shall double slope from centerline to edge. The roof shall extend a minimum of 6" beyond the wall panel on each side and have a turndown design which extends 1" below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge. Roof slabs shall be designed to clear span without intermediate internal support. Slight alterations in the overhang and turn-down dimensions per the manufacturer's current standards will be allowed.
 - D. Keyway Roof Joints: If the roof structure consists of multiple panels, grout in keyway shall be polymer concrete placed after coating keyway with a methyl methacrylate resin and isocyanate resin.
 - E. Floor: There shall be a $1 \frac{1}{2}$ deep recess, the width of the wall panels, cast into the floor. The $1 \frac{1}{2}$ recess makes the interior floor surface $1 \frac{1}{2}$ higher than the joint between the wall panel and floor slab preventing intrusion of water.

F. Walls shall be of an insulated precast concrete sandwich panel type. The walls shall have an extruded polystyrene core sandwiched between interior and exterior concrete wythes. The wall panels shall have a minimum thickness of 6½". Minimum wythe thickness shall be 2". The walls shall have a minimum equivalent R-value of R-26 per the 2015 International Energy Conservation Code.

1.05 SUBMITTALS

- A. Building engineering calculations that are designed and sealed by a Professional Engineer, licensed in the State of Texas, shall be submitted for review.
- B. Manufacturer shall submit color swatches of interior and exterior paint for Owner's approval.
- C. Manufacturer shall submit a wall mock-up with the textured and smooth finishes, including tooled joints, to the owner for approval prior to wall panel fabrication.

1.06 WARRANTY

- A. The Manufacturer shall provide a ten (10) year warranty from the date of successful start-up and Owner acceptance for the precast concrete structure to be free of defects material and/or workmanship under normal use and service.
- B. All other components supplied as part of the precast concrete structure shall be warranted for a period of two (2) years from the date of successful start-up and Owner acceptance.
- PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: Steel-reinforced, 6000 PSI minimum 28-day compressive strength.
- B. Reinforcing Steel: ASTM A615, grade 60 or ASTM A1064, grade 80 unless otherwise indicated:
 - 1. Post-tensioning Strand: Roof shall be post-tensioned in field after keyway is filled and has cured to required strength (psi). Post-tensioned cable shall be 41K Polystrand CP5O, .50 in., 270 KSI, 7-wire ungreased strand (ASTM A416). There shall be a minimum of three post-tensioning cables connecting roof panels together to provide watertight joint.
- C. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be SIKAFLEX-IA elastic sealant or equal. Exterior caulk joint to be 3/8" x 3/8" square so that sides of joint are parallel for correct caulk adhesion. Back of joint to be taped with bond breaking tape to ensure adhesion of caulk to parallel sides of joint and not the back.
- D. Panel Connections: All panels shall be securely fastened together with 3/8" thick stainless steel brackets. Steel is to be of structural quality, stainless steel complying with ASTM F593. All fasteners to be 1/2" diameter 304 stainless steel bolts complying with ASTM F593 for stainless steel, hex caps screws, and studs. Cast-in anchors used for panel
 BPUB LIFT STATION REHABILITATION 13120 3 PRECAST CONCRETE BUILDING PREFABRICATED

connections to be Dayton-Superior #F-63, or equal. All inserts for corner connections must be secured directly to form before casting panels. Floating of connection inserts will not be allowed.

2.02 ACCESSORIES – (TO BE PROVIDED BY PRECAST BUILDING MANUFACTURER)

- A. Door and Frame: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-I00), and as also herein specified. The building shall be equipped with doors as indicated on the drawings. Doors shall be single or double 3'-0" x 7'-0" or 9'-0" per the Door Schedule x 1³/₄", Hollow Metal doors, with insulated core and galvanized. Doors shall open as noted on drawings. Frames shall be Hollow Metal. Doors and frames shall be painted with one coat of primer and one finish coat of epoxy paint, medium gray, if no other color is specified.
- B. Door Hardware:
 - 1. Handle: Lindstrum pull-handle stainless steel, $8-1/2'' \ge 2''$, or equal at exterior. Interior shall be panic-bar full width.
 - 2. Lockset: Cal-Royal lever lock or Easi-Set or equal.
 - 3. Deadbolt: Yale or Easi-Set stainless steel keyed outside only or equal.
 - 4. Hinges: Hagar stainless steel five knuckle ball bearing with non-removable pins or equal.
 - 5. Threshold: Hagar or National Guard Products extruded aluminum with neoprene seal or equal.
 - 6. Overhead Door Holder: Yale surface mounted overhead slide type with safety release or equal.
 - 7. Drip Cap: Hager or National Guard Products aluminum with stainless steel screws or equal.
 - 8. Door Closer: Norton 7500 or Yale 4410 with hold open or equal.
 - 9. Surface Bolts (Upper and Lower): Magnokrom Inc. 400-401 cadmium plated finish or equal, as required for double doors.
 - 10. Astragal: Galvanized steel, same finish and brand as door, as required for double doors, removable.
 - 11. Door Stop: Ives 445B26D brushed chrome (inactive leaf only) or equal, as required for double doors.

2.03 HVAC - (TO BE PROVIDED BY PRECAST BUILDING MANUFACTURER)

- A. HVAC systems shall consist of through-wall air conditioning (AC) unit(s). Building manufacturer shall coordinate all aspects of providing the specified HVAC systems including, but not limited to, equipment, materials, labor, conduit, wiring, etc.
 - 1. The AC units serving the Electrical Room shall be sized for the building envelope loads using ASHRAE minimum 'R' values and ASHRAE weather data, and include both outside air loads and internal heat gain from the electrical equipment. AC units shall be located to distribute airflow throughout the space and not blow directly into electrical equipment.
 - 2. Provide separate condensate dry wells and piping for each AC unit.
- B. Equipment shall be 277/480 V.
- C. Materials shall be aluminum with stainless steel fasteners, unless noted otherwise.
- D. Provide a wall mounted thermostat for each AC unit.
- E. Refer to Switchgear Building HVAC drawings for similar plan drawings, details, and schedules. Contractor shall provide same manufacturer/model numbers, ductwork, insulation, grilles/diffusers, piping, etc as required for the Switchgear Building.
- F. The following table includes preliminary sizing of the HVAC equipment. Building Manufacturer shall verify HVAC equipment sizes indicated with proposed electrical equipment and building construction. Notify engineer of any discrepancies or changes.

Table 1 – HVAC Equipment			
Тад	Serves	Size	
AC-1	Electrical Room	1.5 tons	

2.04 LIGHTING

- A. External lights shall be provided on each building, adjacent to doors and as shown on the plans. Lights shall be per Electrical drawings and specifications.
- B. Interior lighting shall be provided per the Electrical drawings and specifications.
- C. Building manufacturer shall coordinate all aspects of providing a working lighting system including, but not limited to, equipment, materials, labor, conduit, wiring, switches, etc.
- 2.05 EMERGENCY APPURTENANCES
 - A. Building shall be provided with emergency exit signs and emergency lighting as required by code and Electrical drawings and specifications.

2.06 FINISHES

- A. Interior of Building: Smooth steel form finish on all interior panel and ceiling surfaces, painted white with two coats of Super Diamond Clear VOX as manufactured by The Euclid Chemical Company, or equal.
- B. Exterior of Building: Architectural precast smooth 8" x 16" running bond concrete masonry unit finish: Finish shall be imprinted in top face of panel while in form using an open grid impression tool. Face of panels shall be coated with an acrylic concrete stain: FOSROC; or United Coatings. Stain color will be as selected by Owner. Stain shall be applied per Manufacturer's recommendation.
- C. Doors shall be painted to match existing buildings on site.

PART 3 EXECUTION

- 3.01 SITE PREPARATION REQUIREMENTS (CAST-IN-PLACE FLOOR)
 - A. Concrete floor slab will be constructed by the Contractor as indicated on the structural drawings. The floor slab will be designed to support the anticipated load of the building walls and its contents.
 - B. The floor shall have a 1 1/2" deep recess, the width of the wall plus 3 1/2" wide cast into the floor around the perimeter except at doors. The 1 1/2" recess shall make the interior floor surface 1 1/2" higher than the joint between the wall panel and the foundation preventing intrusion of water.
 - C. The finished floor slab elevation will be above the exterior grade. The grade will have a positive slope and drainage away from the building at all points.
 - D. Concrete slab to be steel reinforced and level within 1/8" in both directions.
 - E. Foundation depth and reinforcement to be in accordance with design drawings.
 - F. Corner of slab must be square, not chamfered, to allow for proper sealant joint.

3.02 ACCESS

- A. Contractor shall provide level unobstructed area large enough for crane and tractor/trailer to park adjacent to pad. Crane shall be able to place outriggers within 5'-0" of edge of pad and truck and crane must be able to get side-by-side under their own power. No overhead lines may be within 75' radius of center of pad.
- 3.03 ERECTION OF BUILDING
 - A. Erection of building shall be performed by building manufacturer or by a sub-contractor authorized and approved by the building manufacturer. Erection shall be in complete accordance with the requirements of the building manufacturer.

B. After completion of the work, Building Manufacturer shall engage an engineer licensed in the State of Texas to inspect the work and prepare a certification that the work has been done in complete accordance with these specifications and their requirements.

END OF SECTION

SECTION 15000

SPECIAL CONDITIONS FOR MECHANICAL WORK

PART 1 GENERAL

1.01 GENERAL

- A. The Work to be accomplished under these Specifications includes all labor, materials and equipment required for the complete installation as described herein and as indicated on the mechanical drawings for the Project. Drawings, General and Supplementary Conditions, and Division 1 - General Provisions, Specification Sections, apply to Work of this section.
- 1.02 SPECIAL CONSIDERATIONS
 - A. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be provided as though shown and mentioned in both.
 - B. Coordinate the mechanical Work with all other trades to determine whether there will be any interference by such trades with the mechanical Work.
 - C. Investigate structural and finish conditions and arrange Work accordingly, furnish all fittings and accessories required to meet conditions and give satisfactorily operation. Coordinate with other Contractors and Subcontractors to avoid interference with their Work. The right to make any reasonable change in the location of outlets, apparatus, and equipment up to time of roughing-in is reserved by the OWNER's Representative without involving any additional expense to the OWNER.
- 1.03 SITE INSPECTION
 - A. All bidders submitting proposals for the Work shall first examine the site and all existing conditions. The lack of specific information on the drawings shall not relieve the bidder's responsibility for taking into account all site conditions in his proposal.

1.04 CODES, STANDARDS AND PERMITS

- A. Work to conform to the latest editions of the following:
 - 1. ASHRAE
 - 2. All applicable city, state and national codes.
 - 3. Requirements of local utility companies.
 - 4. Underwriter's Laboratories, Inc., and shall be so labeled.
 - 5. NFPA.
 - 6. OSHA.
 - 7. Applicable AWWA Standards.
 - 8. Applicable ASTM Standards.

- B. In case of difference between applicable codes, specifications, utility company regulations and the Contract Documents, the most stringent shall govern.
- C. Obtain all permits, inspections and approvals applicable to the mechanical trade, as required by regulatory authorities. All fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid. Obtain and pay for all the necessary certificates of approval, which shall be delivered to the OWNER before final acceptance of the Work.
- D. The MANUFACTURER's published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material.
- 1.05 SHOP DRAWINGS AND SUBMITTALS
 - A. The CONTRACTOR shall submit complete information on all items in this division of the specifications where submittals are required to the OWNER for review. Shop drawings and submittal information shall be clearly indexed and marked to indicate the proposed items of equipment.
 - B. The CONTRACTOR shall indicate in the submittals the actual operating characteristics of the proposed equipment at the specified design conditions. Submittals which are equipment brochures only and that do not clearly indicate capacities at scheduled conditions are not acceptable.
 - C. The review of submittals will be general in nature, and approval shall not be considered:
 - 1. As permitting any departure from the Contract requirements.
 - 2. As relieving the CONTRACTOR of the responsibility for any errors, including details, quantities, dimensions, materials, etc.
- 1.06 OPERATION AND MAINTENANCE MANUAL
 - A. An operation and maintenance manual for each mechanical system and for each piece of equipment shall be furnished by the CONTRACTOR. The manual shall include, but not be limited to, the following:
 - 1. A system layout showing piping, valves, and controls.
 - 2. Wiring and control diagrams.
 - 3. A control sequence describing start-up, operation and shutdown.
 - 4. Installation instructions.
 - 5. Maintenance and overhaul instructions.
 - 6. Lubrication schedule including type, grade and temperature range, and frequency.
 - 7. Parts lists.
 - 8. Local Supply or otherwise.

1.07 MATERIALS AND MANUFACTURERS

- A. Materials furnished shall be of best quality and grade of standard MANUFACTURER, shall conform to the National Board of Fire Underwriters requirements, and shall bear the Underwriters' seal of approval.
- B. Each item of equipment shall fit plan and space allowed and surrounding conditions and fulfill completely the function for which it is intended as well as item named on drawings or in specifications.

1.08 CONCRETE EQUIPMENT FOUNDATIONS, BASES, AND ROOF CURBS

A. All concrete equipment foundations, bases, and roof curbs as required for the installation of mechanical Work hereinafter specified will be furnished and installed by the CONTRACTOR. The trade installing the mechanical sections of the Work shall be responsible for the proper coordination of its equipment with these bases. Furnish all anchor bolts and other accessories required for casting in these concrete bases.

1.09 PROTECTION OF MATERIALS AND APPARATUS

A. At all times, the CONTRACTOR shall take such precautions as may be necessary to properly protect his apparatus from damage. This shall include the creation of all required temporary shelters to adequately protect any apparatus and the covering of apparatus in the complete building with tarpaulins or other protective covering.

1.10 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of equipment shown on the drawings is based on the dimensions of a particular MANUFACTURER. Where other MANUFACTURERs are acceptable, it is the responsibility of the CONTRACTOR to determine if the equipment he proposes to furnish will fit the space available. Shop drawings shall be prepared by the CONTRACTOR when required by the OWNER's Representative to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces requiring access. Proper clearances shall be maintained to meet all safety and operating codes.

1.11 FLAME SPREAD PROPERTIES OF MATERIALS

A. All materials and adhesives used for air conditioning filters, acoustical lining and insulation shall conform to NFPA and UL life and safety and flame spread properties of materials. The composite classifications shall not exceed 25 for a flame spread rating and 50 for a smoke developed rating for these classifications as listed for the basic materials, the finished, adhesives, etc., specified for each system and shall be such when completely assembled.

1.12 RECORDS FOR THE OWNER

A. The CONTRACTOR shall keep a set of drawings on the job, noting daily all changes made in these drawings in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building and shall, with his request for final payment, turn over a clean, neatly marked

set of reproducible drawings showing "As Installed" Work to the OWNER's Representative for subsequent transmittal to the OWNER.

- B. In addition to the above, the CONTRACTOR shall accumulate during the job's progress the following data, in duplicate, prepared in a neat brochure or packet folder and turned over to the OWNER's Representative for checking and subsequent delivery to the OWNER.
 - 1. All warranties, guarantees and MANUFACTURER's directions on equipment and material covered by the contract.
 - 2. Approved wiring diagrams and control diagrams.
 - 3. Copies of approved shop drawings.
 - 4. Test and Balance report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 15047

IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment and materials required to permanently affix an identification tag on all piping systems, valves and equipment, safety and operation signs by the MANUFACTURER.
- B. As a minimum, the following equipment shall be tagged:
 - 1. Valves 4-inches and larger in diameter
 - 2. Valves equipped with valve actuators (valve and actuator share common number)
 - 3. Portable valve and gate actuators
 - 4. Solenoid valves
 - 5. Process equipment
 - 6. Pumps and Motors
 - 7. Electrical Components, as directed by the OWNER
 - 8. I&C Components, as directed by the OWNER
- 1.02 RELATED WORK
 - A. Shop Drawings, Product Data and Submittals.
 - B. Section 09900 Painting
 - C. Division 11 Equipment
 - D. Division 13 Special Construction
 - E. Section 15061 PVC Pressure Pipe
 - F. Section 15072 Ductile Iron Pipe and Fittings
 - G. Section 16010 Electrical General Provisions
 - H. Section 17000 Instrumentation General Provisions
- 1.03 QUALITY ASSURANCE
 - A. MANUFACTURER shall refer to the related equipment or piping specification for quality assurance requirements.

PART 2 PRODUCTS

2.01 PIPING IDENTIFICATION

- A. General: All exposed piping, unless specified otherwise, shall be painted according to the color code system specified, using paint materials, surface preparation, and application techniques specified in Division 9 Finishes. All exposed piping shall have a product identification label painted on the piping. For pipes with insulation the label shall be painted on the aluminum jacket. Where pipes are too small for such application, a brass identification tag shall be fastened securely at specified locations. Tags shall be a minimum 1½-inch in diameter with depressed black figures of appropriate size. MANUFACTURER shall coordinate with OWNER prior to adding identification to piping.
- B. Identification Label: The label shall consist of a minimum of two coats of paint, with the surface preparation, materials and application of paint conforming to the requirements of Section 09900 Painting.
- C. Location: Labels shall be applied to the piping at locations as follows:
 - 1. Each branch and riser at take-off.
 - 2. At each pipe passage through wall, floor and ceiling construction.
 - 3. At each pipe passage to underground.
 - 4. At not more than 5 feet spacing on straight pipe runs.
 - 5. At each valve, strainer and all pieces of equipment.

Letter Size: The letter sizes corresponding to the applicable outside diameter of pipe or pipe covering shall be used. Upper case letters and Arabic Numerals shall be used. Sizes are as follows:

Outside Diameter	Width of Color	Size of Legend
of Piping Covering	Band or Block	Letters and
		Numerals
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	1/2"
2-1/2" to 6"	12"	3/4"
8" to 10"	24"	3/4"
Over 10"	32"	1"

- D. Labels shall be placed so as to be easily read from operating positions. Adjacent to label, arrows shall indicate the direction of flow of material under normal operating conditions.
 - 1. The legend color shall be either white or black, providing it is a contrast to the color of the band or pipe, except as noted below.
 - 2. The band or block color and product shall include but not be limited to the following:
| Product/Legend | Color of Pipe |
|--|-----------------------------------|
| Wastewater Line | Grey |
| Sludge Line | Brown |
| Potable Water | Safety Blue |
| Non Potable Water | Purple |
| Compressed Air | Light Green |
| Instrument Air | Light Green with Dark Green Bands |
| Chlorine/Sodium Hypochlorite
(gas, liquid, or vent) | Yellow |
| Chlorine/Sodium Hypochlorite
(solution) | Yellow with Red Bands |

- 3. Piping color coding shall conform to 30TAC Ch 217, § 217.329. The OWNER will select the final colors during the submittal process. Any identification made prior to OWNER selection shall be at the CONTRACTOR's expense.
- E. CONTRACTOR shall refer to the related piping specification for requirements on buried pipeline marking tape.
- 2.02 EQUIPMENT IDENTIFICATION
 - A. CONTRACTOR shall coordinate with OWNER prior to adding identification to equipment.
 - B. Titles shall be provided on all equipment, including pumps and blowers using 1 inch high Helvetica Medium upper case, Grid 2 spacing, white in color except as otherwise noted on the drawings in these specifications. Titles shall include the facility ID, process ID, unit operation equipment type ID and unit number, as indicated in the equipment ID numbering as shown on sheet M-1, this section, or as otherwise indicated by the OWNER. Prior to labeling/placing equipment identification, CONTRACTOR shall coordinate with OWNER and submit titles for review. Titles shall be mounted at eye level on machines where possible or at the upper most board vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, the items shall be numbered consecutively as indicated in the Contract Documents, or as directed by the OWNER; for example PMP-221, PMP-222, etc.
 - C. Titles shall be sized, proportioned, arranged and located to be easily readable. It may be required by the OWNER that some equipment be labeled in two or more places, in which cases, the CONTRACTOR shall comply with no additional cost to the OWNER. All submersible pumps shall be labeled twice: once on the pump itself, and once on the concrete or metal plate at the top of the pump's guide pipes.

- D. The CONTRACTOR shall submit for OWNER's review in accordance with Division 1 General Provisions a listing of all equipment titles he proposes to provide, including for each equipment's labeling:
 - 1. Size and color of letters to be used.
 - 2. Location(s) of labels.
 - 3. Formation of label, for example

Booster Pump No. 1 PMP-221

- E. It is the intent of these specifications that all equipment items be labeled and that such labeling allows easy identification of the item of equipment from the direction(s) from it shall most normally be viewed.
- F. Final coat of paint for equipment shall conform with requirements in Section 09900 -Painting, for surface preparation, materials and application. Motors, Pumps, Blowers, Valves, Guards and Shields shall be painted Safety Orange and Exposed Moving parts shall be painted Safety Red. The OWNER shall select final colors during the submittal process. Any identification made prior to OWNER selection shall be at the CONTRACTORS expense.
- 2.03 EQUIPMENT ID NUMBERING
 - A. Refer to M-1 of the Project Plans.
 - B. Assembly Logic: An equipment sequence number identifies all elements common to a machine. The individual components of the machine are not further identified, except in motors or drives or pumps as they are frequently "moved around." For Example, a return sludge pump would share its number with its motor, base, gear box, discharge piping, power cable, and motor starter, including the "start/stop" circuitry and console buttons. This commonality of elements also is a plant safety feature when isolating units for repair, as only a single identifier need to be remembered. Is also keep equipment tagout/lockout systems simplified.
 - C. In a case of movable equipment such as portable pumps or portable air compressors, the Process Area Number will identify the current plant location.

PART 3 EXECUTION

3.01 INSTALLATION

The installation of identification for piping systems, valves and equipment shall be as specified above.

PVC PRESSURE PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required and install Polyvinyl Chloride (PVC), fittings and appurtenances in accordance with the Contract Documents.
- B. The CONTRACTOR shall install PVC:

The following pipe shall be have impact production specification of greater than 210 lbs per sq inch for 4", 305 lbs per sq inch for 6" and 500 lbs per sq inch for 14" PVC pipe in accordance with ASTM D2444: Refer to the Contract Drawings for additional information.

- C. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals necessary to install PVC Pressure Pipe and tubing in the yard as shown in the Contract Drawings.
- 1.02 SUBMITTALS
 - A. Shop Drawings: Submit shop drawings and product data in accordance with BPUB General Conditions for following:
 - 1. Piping layouts and schedules, including dimensioning, fittings, locations of valves, and appurtenances, joint details, methods and locations of supports.
 - 2. All data and information required for the complete piping systems. Dimensions shall be based on the field condition and actual equipment to be installed.
 - B. Certificates:
 - 1. Prior to shipment of pipe, submit certified test reports that the pipe for the Contract was manufactured and tested in compliance with ASTM Standards specified.
 - 2. Gasket MANUFACTURER shall submit written certificate that gasket material is suitable for the joints provided, recommended for the chemical contained in the pipe, and suitable for the test pressure and service conditions.
 - C. PVC water pipe shall bear the seal of approval (or "NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water.

1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. D1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 - 2. D2241 Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

- 3. ASTM D2444-19 Standard Practice for Determination of Impact Resistance of Thermoplastic Pipe
- 4. D2564 Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- 5. D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
- 6. D2855 Specification for Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- 7. ASTM D2774 12 Standard Practice for Underground Installation of Thermoplastic Pressure Pipe.
- 8. D3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- 9. F442 Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
- 10. F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- 11. F493 Solvent Cements for chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
- 12. NSF 61 Drinking Water System Components Health Effect
- 13. NSF 14 Plastic Pipe System Components and related materials.

1.04 QUALITY ASSURANCE

- A. PVC pipe and fittings shall be from a single MANUFACTURER. PVC pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with these Specifications by an Independent Testing Laboratory selected by the OWNER. The OWNER shall require the MANUFACTURER's cooperation in these inspections. The cost of initial inspections at the plant will be borne by the OWNER. The cost of additional inspections deemed necessary by the OWNER because of the failure of the pipe to meet the specification shall be borne by the OWNER.
- B. Inspection of the pipe and fittings will be made by the OWNER after delivery. The pipe or the fittings shall be subject to rejection at any time on account of failure to meet Specification requirements, even though they may have been accepted as satisfactory at the place of manufacture. Pipe or fittings rejected after delivery shall be marked for identification and shall immediately be removed from the job.
- C. Materials used in manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards, as applicable.
- D. Pipe shall be homogenous throughout and free from voids, cracks, inclusions and other defects, and shall be uniform as commercially practicable in color, density and other physical characteristics.
- 1.05 DELIVERY, HANDLING AND STORAGE
 - A. Care shall be taken in loading, transporting, and unloading pipe and fittings to prevent damage to the items. Pipe, fittings and accessories shall be carefully inspected before installation and those found defective shall be rejected. Pipe and fittings shall be free

from fins and burrs. Handling and installation of pipe and fittings shall be in accordance with the MANUFACTURER's instructions, referenced standards and as specified.

B. Store pipe, fittings, and accessories at the site in unit packages provided by the MANUFACTURER. Exercise caution to avoid damage or deformation of the pipe. Store pipe in such a way as to prevent sagging or bending and be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Store gaskets in cool, dark place out of the direct rays of the sun, preferably in original cartons.

PART 2 PRODUCTS

- 2.01 PVC PRESSURE PIPE
 - A. Pipe shall be made from virgin PVC resin that has compounded to provide physical and chemical properties that equal or exceed cell Class 12454 as defined in ASTM D1784. PVC pipe shall conform to the requirements of ASTM D1785, Type I, Grade 1.
 - B. Pipe shall have impact production specification of greater than 210 lbs per sq inch for 4", 305 lbs per sq inch for 6" and 500 lbs per sq inch for 14" PVC pipe in accordance to ASTM D2444.
 - C. Product delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to ASTM D2241. The restrained joint pipe system shall also meet all short and long term pressure test requirements of ASTM D2241. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.
 - D. Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837. 16" high-pressure couplings shall be made from glass-reinforced thermoset filament-wound materials. Fittings, specials, unions, and flanges shall be of the same schedule number and manufactured of the same materials as the pipe
 - E. Sweeps and Couplings, shall be of the same 2241 number and manufactured of the same materials as the pipe.
 - F. Couplings shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.
 - G. The following pipe shall have impact production specification of greater than 210 lbs per sq inch for 4", 305 lbs per sq inch for 6" and 500 lbs per sq inch for 14" PVC pipe in accordance to ASTM D2444.
- 2.02 SECONDARY CONTAINED PROCESS PIPE AND FITTING SYSTEM
 - A. PVC primary and secondary pipe and fittings for the double containment process piping systems installed below grade shall be Schedule 80 joined by the solvent cement joining method. Pipe and fittings shall be manufactured of polyvinyl chloride

(PVC). Material shall safely convey flow streams up to 140° F (60° C) at a pressure rating of 150 PSI.

2.03 PVC FITTINGS AND SWEEPS

- A. The Yelomine[™] formulation will contain sufficient impact resistant modifiers to demonstrate approximately twice the Izod impact level of conventional white PVC pipe. Production records and independent laboratory test data shall be available upon request.
- B. PVC Sweeps shall be manufactured by the following:1. NAPCO Pipe & Fitting

2.04 FITTINGS

- A. The following Fittings are approved for use inside the lift station to connect to the PVC pipe.
 - 1. Ford RCDP Restrained Couplings manufactured by Fort Meter Box Company with epoxy coating via electro-coat process. Transition gaskets shall be Buna-N rubber.
 - 2. Yelomine Fabricated 90° Ell's with Certa-Lok coupling.
 - 3. EBAA Iron Series 2000PV Mechanical Joint Restraint for PVC pipe with Denso wax tape.
- PART 3 EXECUTION

3.01 INSTALLATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. All pipe fittings shall be equally cleaned before assembly.
- B. All PVC pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall be installed to provide maximum headroom and access to equipment, and where necessary all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. All installations shall be acceptable to the OWNER's Field Representative. OWNER shall strictly follow MANUFACTURER's installation recommendations and requirements of this specification for assembly, chamfering of plain ends, applying solvents, and supporting pipe.
- C. Supports and Anchors: All piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 15140 Supports and Hangers. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed.
- D. Valves and Unions: Unless otherwise indicated, all connections to fixtures, groups of fixtures and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

- E. Provisions for expansion shall be made for PVC pipes to tolerate:
 - 1. A 100 degree F change in operating temperature using an expected maximum of 135 degree F.
 - 2. Expansion loops and guides shall be installed to compensate for pipe expansion due to temperature differences.
 - 3. Buried PVC piping shall be snaked along the trench to provide for expansion and contraction.
 - 4. Pipe shall be manufactured only have impact production specification of greater than 210 lbs per sq inch for 4", 305 lbs per sq inch for 6" and 500 lbs per sq inch for 14" PVC pipe in accordance to ASTM D2444:
 - 5. Where PVC pipe passes through wall sleeves, the space between the pipe and sleeve shall be sealed with a mechanical type wall seal as specified in Section 15120-Piping Specialties.

3.02 PVC PIPE JOINTS

- A. Pipe shall be joined using PVC couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.
- 3.03 Couplings shall incorporate twin Teflon-coated elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139.

3.04 FLANGE PIPE JOINTS

- A. Flanged joints shall be made with gaskets suitable for chemical within the pipeline and Hastelloy C-267 bolts and nuts. Care shall be taken not to over torque the bolts. PVC pipe to metal pipe connections shall be made using flanged connections.
- B. Metal pipe shall not be threaded into PVC fittings, valves, or couplings nor shall PVC piping be threaded into metal valves, fittings or couplings. Only socket to thread adapters shall be used for threaded connections.

3.05 INSPECTION

A. All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the ENGINEER.

3.06 DETECTABLE UNDERGROUND WARNING TAPE

A. Detectable underground warning tape shall be installed within the final backfill of the trench at a maximum bury depth of 24-inch. The tape shall be installed in accordance with the MANUFACTURER's instructions.

3.07 FIELD TESTING

A. Field Testing: All piping systems shall be pressure tested prior to being placed into operation. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times

the maximum working pressure. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices.

- B. Pipes shall be tested hydrostatically, slowly filling the system from the lowest point and taking care to remove any entrapped air by opening vents at high points. Connect a pressure gauge and slowly build pressure in 25 PSI increments, checking for leaks throughout the system or through loss of pressure. If no leaks or loss of pressure is detected, the system should be brought to final test pressure according to local code requirements or to 150% of maximum operating pressure (not rate pressure) for a period of one (1) hour.
- C. All leaks shall be repaired prior to startup of the system. No leaks will be allowed in any chemical lines.
- 3.08 DISINFECTION OF PIPELINES
 - A. Pipelines designated to carry potable or utility water shall be chlorinated prior to being placed into operation.

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install, in the locations inside, under and outside of structures as shown on the Drawings, all ductile iron piping, cast iron or ductile iron fittings, and appurtenances as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Division 2 Site Work.
- B. Division 3 Concrete.
- C. Section 15140 Supports and Hangers.

1.03 DESCRIPTION OF SYSTEMS

- A. Piping shall be installed in those locations as shown on the Drawings.
- B. The equipment and materials specified herein is intended to be standard types of ductile iron pipe and cast-iron or ductile iron fittings for use in transporting water.

1.04 QUALIFICATIONS

A. All of the ductile iron pipe and cast-iron or ductile iron fittings shall be furnished by the Manufacturer's who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

1.05 SUBMITTALS

- A. Submit to the Engineer in accordance with Section 01300, a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.
- B. All ductile iron pipe and cast iron or ductile iron fittings to be installed under this Contract shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Owner sworn certificates of such tests and their results. In addition, all ductile iron pipe and fittings to be installed under this Contract may be inspected at the foundry for compliance with these Specifications by an independent testing laboratory selected by the Owner. The Manufacturer's cooperation shall be required in these inspections.
- C. Shop Drawings including piping layouts within, under, or between structures shall be submitted to the Engineer for approval in accordance with General Requirements and shall include dimensioning, methods and locations of supports and all other pertinent technical specifications for all piping to be furnished.

- D. Submit product data on pipe, fitting and appurtenances describing materials of construction and dimensional data.
- E. Verifiable Certificate of Compliance with the NSF 61 Standard for all pipe and fittings.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Ductile Iron Pipe:
 - 1. Ductile iron pipe shall conform to the requirements of AWWA C150 and AWWA C151.
 - a. Use thickness Class 53 for interior and flanged pipe.
 - b. Use thickness Class 52 for other applications.
 - 2. Ductile iron piping and fittings shall be double thickness cement mortar lined and bituminous seal coated in accordance with AWWA C104. Provide Manufacturer's standard bituminous coating inside and outside of all ductile iron pipe and fitting, except exposed pipe and fittings shall be shop primed and field painted on the outside as specified in Section 09900.
- B. Fittings: Exposed pipe shall be flanged unless noted otherwise. Exposed fittings for use with flanged joints on ductile pipe shall be cast iron or ductile iron fittings conforming to ANSI B16.1 or AWWA C110. Flanges shall be faced and drilled in accordance with ANSI B16.1, Class 125. All fittings shall be pressure rated at 250 psig. Buried fittings shall be restrained mechanical joints.
- C. Flanges: All above grade pipe shall be flanged unless noted otherwise. Flanges for ductile or cast iron pipe shall be ductile or cast iron flanges screwed on threaded ends of the pipe. Flanges shall conform to ANSI B16.1, Class 125. Screwed-on flanges shall be attached to the pipe in the shop; attachment, aligning and facing shall conform to AWWA C115.
- D. Mechanical Joints: Mechanical joints shall only be used on buried pipe or where specifically noted on the drawings for exposed pipe. Mechanical joints for use with ductile iron pipe shall conform to AWWA C111 and shall be restrained. Carefully assemble mechanical joints in accordance with the Manufacturer's recommendations. Lubricate joint surfaces with heavy vegetable soap solution immediately prior to installing gasket on spigot end. If seal is defective, disassemble the joint, thoroughly clean it, and reassemble the joint. Do not over tighten bolts to compensate for poor installation practice.
- E. Seal strips, where required on the Drawings shall be link seal as manufactured by Thunderline Corporation, Wayne, Michigan, or equal.
- F. Sleeve Type Couplings (use only where specifically indicated on the drawings):
 - 1. Sleeve-type couplings shall be as made by Dresser Manufacturing Division, Bradford, PA, Smith-Blair, Inc., San Francisco, California, R.H. Baker & Company, Inc., Huntington Park, California, or equal.

- 2. Couplings for buried pipe shall be of cast iron and shall be Dresser Style 39, Smith-Blair Style 416, Baker Allcast, or equal. The couplings shall be provided with stainless steel bolts and nuts unless indicated otherwise.
- 3. Couplings for exposed pipe shall be of steel and shall be Dresser Style 38, Smith-Blair Style 411, Baker Allsteel, or equal. The couplings shall be provided with black steel bolts and nuts unless indicated otherwise.
- 4. All couplings shall be furnished with the pipe stop removed.
- 5. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
- 6. Joint harness shall be provided on all couplings and shall be designed for the maximum pressures to which the line will be subjected.
- G. Restrained joints shall be "Flex-Ring" or "Lock Ring" by American Cast Iron Pipe Company or equal.
- H. Filler flanges and beveled filler flanges shall be furnished and installed as required. Filler flanges and beveled filler flanges shall be furnished faced and drilled complete with extra length bolts. Filler flanges shall be Clow Figure F-1984 or equal and beveled filler flanges shall be Clow Figure F-1986 or equal.
- I. Polyethylene Encasement. Encasement for buried pipe shall be 8 mil continuous polyethylene encasement conforming to AWWA C105.

PART 3 EXECUTION

- 3.01 HANDLING PIPE AND FITTINGS
 - A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as recommended by the Manufacturer.
 - B. All pipe and fittings shall be subjected to a careful inspection and hammer test just prior to being installed.
 - C. If any defective pipe is discovered after it has been laid it shall be removed and replaced with a sound pipe in a satisfactory manner at no expense to the Owner. All pipe and fittings shall be thoroughly cleaned before installing, shall be kept clean until they are used in the work, and when installed, shall conform to the lines and grades required.

3.02 LAYING EXTERIOR PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA Standard Specification C600 except as otherwise provided herein. For buried piping a firm, even bearing throughout the length of the pipe shall be constructed by tamping selected material at the sides of the pipe up to the springline.
- B. All pipe shall be sound and clean before installing. When installing is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plug or

other approved means. Good alignment shall be preserved in installing. Fittings, in addition to those shown on the plans, shall be provided, if required, to avoid interference with existing piping, conduit, etc. Provide restrained mechanical coupling where required for closures and fitup.

- C. When pipe cutting is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a Tyton bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Joint restraint shall be provided on all piping. Buried piping shall be polyethylene encased in accordance with AWWA C105.
- E. Unless otherwise shown or approved by the Engineer, all outside pipe lines shall have a 5 foot minimum cover.
- F. Jointing Ductile-Iron Pipe:
 - 1. Mechanical joints at valves, fittings, and where designated shall be in accordance with the "Notes on Method of Installation" under ANSI Specification A 21.11 and the instructions of the Manufacturer (use on buried pipe and only where indicated on the drawings on exposed pipe). To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tight to the specified torques. Under no condition shall extension wrenches or pipe over handle or ordinary ratchet wrench be used to secure greater leverage.
 - 2. Flanged joints shall be made using ring gaskets of rubber with cloth insertion. Gaskets 12-inch in diameter and smaller shall be 1/16-inch thick; larger than 12-inch 3/32-inch thick. Flanged joints shall be made with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same American Standard Specification for Low-Carbon Steel, Externally and Internally Threaded Standard Fasteners, Designation A307-68. Bolt studs and studs shall be of the same quality as machine bolts. Bolts in flanged joints or mechanical joints shall be tightened alternately and evenly. After installation two heavy bitumastic coatings comparable to Inertol No. 66 Special Heavy shall be applied to bolts and nuts.
 - 3. Use sleeve-type coupling where required for closures and fitup and where indicated on the drawings. Fully restrain all sleeve couplings. Prior to installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8 inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, by use of a torque wrench of the appropriate size and torque for the bolts. The correct torque as indicated by a torque wrench shall not exceed 75 ft.lb. for 5/8-inch bolts and 90 ft.lb. for 3/4-inch bolts.

- 4. All valves, fittings and other appurtenances needed upon the pipe lines shall be set and jointed as indicated on the Drawings or as required.
- 5. After assembly and inspection and before backfill, all exterior surfaces of buried sleeve coupling and bolts and nuts shall be heavily and thoroughly coated with an approved heavy-bodied (high solids content) bituminous mastic.

3.03 TESTING

A. All pipe lines shall be hydrostatically tested for leakage in accordance with procedures outlined in Section 15001, Plant Piping - General, for compliance with the specifications.

SUPPORTS AND HANGERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR SHALL provide all labor, materials, equipment, tools and related items required to furnish and install all pipe hangers, brackets, saddles, clamps and pipe rolls for all types of piping and duct systems. Pipe hangers and supports shall be furnished complete with all necessary inserts, bolts, nuts, threaded rods, washers and other accessories.
- 1.02 RELATED WORK
 - A. Division 15 Mechanical
- 1.03 QUALITY ASSURANCE
 - A. Pipe supports shall be manufactured by a company regularly engaged in the production of pipe supports such as B-Line, Elcen, Fee and Mason, Grinnel or Anvil International.
 - B. Other Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.
 - 1. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
 - a. SP-58 Pipe Hangers and Supports, Materials Design and Manufacture.
 - b. SP-69 Pipe Hangers and Supports, Selection and Application. (Application for copies should be addressed to the Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street N.E., Vienna, VA 22180.)

1.04 SUBMITTALS

- A. Submittals and Shop Drawings, Product Data and Samples, and shall include the maximum load carrying capacity of the support and the support system arrangement.
- B. Submit product data and details on each support.
 - 1. Product data on each support component.
 - 2. Detail of each different type of support on pipe 3 inches and larger.
 - 3. Location of each pipe support on pipe 3 inches and larger.

1.05 DESIGN CONDITIONS

A. In certain locations, pipe supports, anchors, and expansion joints have been shown on the drawings, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be the CONTRACTOR's responsibility to design, furnish and install a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with this section. Additional pipe supports may be required adjacent to expansion joints or couplings.

- B. Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections or, in the absence of such requirements, as permitted by the ENGINEER.
- C. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports with pipes full of fluid.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Design and Construction. Pipe hangers and supports shall be designed and constructed to meet the requirements of MSS SP-58 and SP-69.
- B. All hangers, brackets and clamps shall be standard weight galvanized steel, unless noted otherwise. Do not use perforated strap hangers. When two (2) or more pipes are run parallel, they may be supported on trapeze hangers.
- C. All submerged piping, as well as piping, conduits and equipment in hydraulic structures within 24 inches of water level shall be supported with support assemblies including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless noted otherwise.
- D. All piping in chemical and corrosive areas shall be supported with support assemblies including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP unless noted otherwise.
- E. Unless otherwise shown on the drawings, all horizontal runs of piping suspended from the walkways or roof construction, as the case may be, shall be suspended by means of approved hangers.
- F. All individually suspended horizontal pipes in the building shall be supported by galvanized steel rods sized as follows:

Pipe Size (in Inches)	Rod Size (in Inches)
2 and smaller	3/8
2-1/2 - 3-1/2	1/2
4 - 5	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 24	1-1/4

- G. Channel struts and pipe clamps may be used to support multiple lines running in close proximity. Use expansion shields with bolts and horizontal drilled holes in existing concrete construction to support new piping.
- H. Metal Framing:
 - 1. Provide channels fabricated from not less than 12-gauge sheet steel, 1-5/8" wide and not less than 1-5/8" deep.

- 2. Coatings:
 - a. Galvanizing: Hot-dip galvanize all steel components.
 - b. PVC: At the factory, apply a minimum 10-mil-thick PVC coating, bonded to metal.
- 3. Use stainless steel channels and components in all indicated in Paragraph C and D of this section and/or shown on drawings. Use hot-dipped galvanized steel components in all other areas.
- 4. All anchor bolts shall be Type 316 stainless steel as specified in Section 05501. Space anchor bolts a maximum of 24" on center, with not less than two bolts per piece of framing.
- 5. Acceptable MANUFACTURERs: B-Line Systems, Inc.; Elcen Metal Products Company; Power Strut or Unitstrut.
- I. Continuous slotted inserts may be used to support multiple lines running in close proximity on either individual hangers or on trapeze. Use expansion shields with bolts and horizontal drilled holes in existing concrete construction to support new piping.
- J. Hangers supporting and contacting copper lines three inches in size and smaller shall be hinged ring hangers and adjusters. Where pipe hangers and supports come in contact with copper piping provide protection from galvanic corrosion by: wrapping pipe with 1/16 inch thick neoprene sheet material and galvanized protection shield; isolators similar to Elcen Figure 228; or copper plated or PVC coated hangers and supports.
- K. Hangers supporting four inches and larger ferrous pipe shall be with two nuts for each support.
- L. All vertical risers shall be supported by riser clamps or supports at each floor and every eight feet. Install four inch square plate on masonry with attached rod using hangers fastened to risers.
- M. Where supports or anchors are used on copper piping, copper plate U-bolts and chairs or rubber inserts to eliminate dissimilar metal contact.
- N. For horizontal piping along equipment room walls, use brackets with hangers and rods as specified unless otherwise shown on the drawings.
- O. Install supports and hangers to permit free expansion and contraction in the piping system. Where necessary to control expansion and contraction, piping shall be guided and firmly anchored. Anchors shall be accepted by the ENGINEER. Design for equal effectiveness for both longitudinal and transverse thrust. No piping shall be self-supporting, nor shall it be supported from equipment connections. Transmission of vibration, noise, etc., shall be considered, and any special suspension with vibration dampeners to minimize transmission shall be used where necessary. Shooting of anchors into concrete will not be allowed.
- P. Where ducts interfere with the proper location of hangers, furnish and install trapeze hangers.

- 2.02 TYPE
 - A. Pipe hangers and supports shall be selected from one of the types shown on Figure 1 of MSS-58 and MSS-69 or as indicted on the drawing, where applicable. Plastic pipe support spacing shall be in accordance with plastic pipe MANUFACTURER recommendations.
- PART 3 EXECUTION

3.01 INSTALLATION

- A. Pipe Support Spacing:
 - 1. General:
 - a. Locate pipe supports at maximum spacing scheduled unless indicated otherwise.
 - b. Provide at least one support for each length of pipe at each change of direction and at each valve.
 - c. Locate pipe supports as shown in Table 3 of MSS-69 for piping not scheduled below or shown otherwise.
 - d. Provide continuous support as required for small tubing to properly support the tubing along the pipe run and at connections to equipment.
 - 2. Steel, stainless steel, ductile iron, cast-iron pipe support schedule:

SIZE - IN
3/8
1/2
5/8
3/4
7/8

3. Copper Pipe Support Schedule:

* MAXIMUM SPAN				
<u> PIPE SIZES - IN</u>	(FT)	ROD SIZE - IN		
2-1/2 and less	5	1/2		
3 thru 6	10	3/4		
8 and greater	15	7/8		

4. PVC, ABS Pipe Support Schedule:

	* MAXIMUM SPA	N
<u> PIPE SIZES - IN</u>	<u>(FT)</u>	ROD SIZE - IN
1-1/4 and less	3	3/8
1-1/2 thru 3	4	1/2
4 and greater	5	3/4

*Maximum fluid temperature of 120 Deg F.

Support spacings apply to continuous spans with no concentrated load.

B. Application:

- 1. Support piping approximately 1-1/2 inches out from the face of walls and at least three inches below ceilings.
- 2. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Epoxy or Expansion (as specified in Division 5) anchors shall be used to fasten supports to existing concrete and masonry.
- 3. Design loads for inserts, brackets, clamps, and other support items shall not exceed the MANUFACTURER's recommended loads.
- 4. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Threaded rods shall be sufficient threading to permit the maximum adjustment available in the support item.
- 5. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.
- 6. Pipe guides shall be provided adjacent to bellows type expansion joints. Guides will not be required when mechanical couplings are permitted as expansion joints. Guides shall be placed on both sides of expansion joints except where anchors are adjacent to the joints. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joint and a second guide with 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be installed as recommended by the MANUFACTURER.
- 7. Concentrated loads (valves, flanges, etc.) shall be supported directly or supported immediately adjacent to the load.
- 8. Changes in the direction shall be supported as close as practical to the fitting to avoid introducing excessive torsional stresses into the system.
- 9. Valves shall be braced against operating torque.
- C. Adjustment: All hangers shall be adjustable. Wall hangers shall have slotted bolt holes. Ceiling hangers shall have turnbuckles. Floor supports shall have extended anchor bolts such that the support can be wedged to proper elevation and grouted. Provide a minimum of one inch of grout.
- D. Pipe Rack: Pipe supported on pipe rack shall be supported on channels manufactured by Unistrut, Powerstrut or equal. Clamp pipes on the channel support by pipe clamps of the same MANUFACTURER.
- E. Touch Up:
 - 1. Touch up all scratches or cuts on steel components with an approved zinc chromate or a 90 percent zinc paint.
 - 2. Use a PVC compound on PVC-coated components.

3.02 INSULATED PIPE

- A. Insulated pipe shall have protective saddles where supported. Insulation shall pass through the supports. Size supports for the full outside diameter of the insulation.
- 3.03 PLASTIC OR FIBERGLASS PIPE
 - A. Plastic or fiberglass pipe shall have cradles and rubber pads to distribute the load over a length of at least six inches, or more if indicated on the drawings, at all supports.

CHECK VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor and materials required and install complete and ready for operation check valves and appurtenances as shown on the Contract Drawings and as specified.
- 1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

- A. Submit shop drawings showing details of construction and dimensions.
- B. Valves specified to be manufactured in accordance with AWWA and/or other standards must be submitted with an appropriate affidavit of compliance.
- C. Operation and Maintenance Manuals: Operating and maintenance instructions shall be furnished as provided in Section 01350 Operation and Maintenance Data. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.04 REFERENCE STANDARDS

- A. American Society of Testing and Materials (ASTM):
 - 1. A126 Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A159 Specification for Automotive Gray Iron Castings.
 - 3. A536 Specification for Ductile Iron Castings.
 - 4. B148 Specification for Aluminum-Bronze Sand Castings.
- B. American Water Works Association (AWWA): AWWA C508 Swing-check Valves for Waterworks Service, 2-in. through 24-in. NPS.

1.05 QUALITY ASSURANCE

- A. Check valves shall be products of Manufacturer's who have a minimum of five years' experience in the manufacture of the particular equipment to be furnished.
- B. Check values of the same type shall be identical, varying only with size and the product of one Manufacturer.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE
 - A. Reference is made to Section 01600 Material and Equipment for additional information.
 - B. Packing and Shipping:

- 1. Care shall be taken in loading, transporting, and uploading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Owner's Representative.
- 2. Prior to shipping, the ends of all items shall be closed to prevent entry of foreign material.
- C. Storage and Protection: Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping Specifications and Manufacturer's information for further requirements.

1.08 MAINTENANCE/SPARE PARTS (NOT USED)

1.09 EXTENDED WARRANTY

- A. Manufacturer/Supplier shall provide a one-year warranty for all specified equipment supplied under this section beginning from the project's substantial completion date. Manufacturer/Supplier shall also submit, on a yearly basis for review, costs needed to extend all the equipment warranty on a yearly basis thereafter.
- B. Manufacturer/Supplier shall submit a complete listing of spare parts for all equipment furnished under this section whether said equipment is or is not made by the Manufacturer. Spare parts list shall include only spare parts recommended for the first year of operation and a current price list for the Owner to choose which parts will be purchased.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General
 - 1. Valves and appurtenances shall have the Manufacturer's name, flow directional arrows, size, and working pressure for which they are designed, cast in raised letters upon appropriate part of the valve body.
 - 2. Valves shall have a minimum working pressure of 250 psi or be of the same working pressure as the pipe they connect to, and suitable for the pressures noted where they are installed.
 - 3. Joints, size and material, unless otherwise noted or required by the Owner's Representative:
 - a. All joints referred to herein shall be of the same type as the pipe or fittings they are connected to.
 - b. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to.
- B. Swing Check Valves
 - 1. Swing Check valves shall be side mounted external arm with air cushioned control.
 - 2. Swing Check Valve with Air Cushion Control
 - a. Referenced Standard: AWWA C508.
 - b. Non-shock working pressure at 100°F: 250 psig unless shown otherwise.

- c. End connections: Flanged.
- d. Body: Full ported cast iron (ASTM A126- Gr. B).
- e. Cover: Bolted, cast iron (ASTM A126- Gr. B).
- f. Disc: Cast iron (ASTM A126- Gr. B).
- g. Disc Arm: Ductile iron (ASTM A536)
- h. Disc Seat: Buna-N.
- i. Shaft: Stainless steel, type 18-8 extending both sides of the body with a lever and weight, using an air cushion cylinder side mounted.
- j. Body seat ring: Aluminum bronze (ASTM B148).
- k. Cover bolts and trim to be stainless steel, type 316.
- I. Pneumatic cylinder: aluminum.
- m. Operator: Adjustable lever arm with weight and air cushion dashpot with adjustable closing speed. The air cushion cylinder shall be constructed of corrosion resistance material and the piston shall be totally enclosed within the cylinder and not open at one end. The cushion cylinder assembly shall be externally attached to the right side of the valve body looking downstream and be adjustable to cushion the closure of the valve. Cushioning shall be by air trapped in the cushion cylinder which shall be fitted with a one way adjustable control check valve to cushion disc contact to the seat at the shut-off point. The bottom cylinder head shall be swivel mounted and not rigid to follow the change of angular force as the lever rises or lowers to open or close the check valve.
- Manufacturers and Products: The manufacturer shall have a minimum of five (5) years experience in the manufacture of resilient, flexible disc check valves with air and hydraulic cushions.
 - (1) Dezurik
 - (2) Val-Matic
 - (3) Approved Equal
- C. Shop Coating
 - Valves and appurtenances requiring painting shall be painted and/or coated by suitable material to prevent rust on components until the time of installation and as noted in Section 09900 – Painting and Coating, if not covered herein or in the Standard Specification noted. All items exposed to view, including in vaults shall have the exterior prepared as noted in Section 09900 – Painting and Coating.
 - 2. All coating in contact with the potable water shall be approved for potable water immersion service per ANSI/NSF Standard 61.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Valves and appurtenances shall be installed per Manufacturer's instruction in the locations shown. Where installation is covered by a referenced standard specification, installation shall be in accordance with that specification, except as herein modified.
 - B. Items shall be carefully inspected for defects in construction and materials; debris and foreign material cleaned out of valve openings, etc.; operating mechanisms operated to check their proper functioning, and nuts and bolts checked for tightness. Valves and other equipment, which do not operate easily, or are defective, shall be repaired or replaced.

- C. Unless otherwise noted, joints for items shall be made up utilizing the same procedures as specified under the applicable-type connecting pipe system.
- 3.02 FIELD TESTING
 - A. Check valves shall be field tested per manufacturer recommendations and corrected for any of deficiencies.
- 3.03 FIELD PAINTING
 - A. Field painting is specified under Division 9 Finishes.
 - B. Field painting shall include touch ups where required.

3.04 CLEANING

- A. All items (including valve interiors) shall be cleaned prior to installation, testing, disinfections, and final acceptance.
- B. Disinfection
 - 1. Disinfection of valves and appurtenances on all potable water lines shall be performed in accordance with Division 17 Instrumentation prior to placing the valves and pipelines in service.

PLUG VALVES

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. The Contractor shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- 1.02 RELATED WORK
 - A. Division 15 Mechanical
- 1.03 SUBMITTALS
 - A. The Contractor shall furnish submittals in accordance with Section 01300 Submittals.
 - B. Valves manufactured in accordance with AWWA and/or other standards must be submitted with an appropriate affidavit of compliance.
 - C. Submit operating and maintenance instructions in accordance with Section 01350.
- 1.04 REFERENCE STANDARDS
 - A. AWWA
 - 1. AWWA C517 Resilient Seated Cast-Iron Eccentric Plug Valves
 - B. ASME International
 - 1. ASME B16.1 Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 - 3. ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 4. ASME B1.20.1 Pipe Threads, General Purpose, Inch.
 - C. ASTM International
 - 1. ASTM A536 Standard Specification for Ductile Iron Castings.
 - 2. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings.
- 1.05 WARRANTY
 - A. Provide warranty as specified in Section 01740 Warranties
- PART 2 PRODUCTS
- 2.01 ECCENTRIC PLUG VALVES (1/2-INCH TO 72-INCH)
 - A. Construction:

- 1. Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A126 Class B Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI B16.1, Class 125 flanged ends for valves 3 inches and larger, and screwed or flanged ends for smaller sizes. Plugs and shafts shall be of ductile iron conforming to ASTM A536 Specification for Ductile Iron Castings and the plugs shall be lined with a resilient coating, best suited for the specific service.
- 2. The body shall be factory epoxy coated.
- 3. All top and bottom shaft bearings shall be of permanently lubricated stainless steel per ASTM A743 Grade CF8M. Grit seals of Teflon, Nylatron, or similar suitable material shall be provided to prevent the entry of grit and solids into the bearing areas.
- 4. All eccentric plug valves shall have a bi-directional pressure rating of not less than 150 psi WOG for bubble tight shut-off in the standard flow direction and 25 psi WOG in the reverse flow direction.
- 5. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions.
- 6. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.
- B. Acceptable Manufacturers:
 - 1. DeZurik Corporation.
 - 2. Val-Matic.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All plug valves shall be installed in strict accordance with the Manufacturer's published recommendation.
- B. Eccentric Plug Valves: The following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:
 - 1. The valves shall be positioned with the stem in the horizontal direction.
 - 2. In horizontal pipelines, the plug shall swing upwards when opening to permit flushing out of solids.
 - 3. The orientation of the valve shall prevent the valve body from filling up with solids when closed. However, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.
 - 4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for all sizes.

3.02 FIELD TESTING

A. Plug valves shall be field tested and corrected for any deficiencies.

AIR AND VACUUM VALVES

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. The Contractor shall provide air and vacuum valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- 1.02 RELATED WORK
 - A. 09900 Painting
 - B. Division 15 Mechanical
- 1.03 SUBMITTALS
 - A. The Contractor shall furnish submittals in accordance with Section 01300 Submittals.
 - B. Valves manufactured in accordance with AWWA and/or other standards must be submitted with an appropriate affidavit of compliance.
 - C. Submit operating and maintenance instructions in accordance with Section 01350.
- 1.04 REFERENCE STANDARDS
 - A. AWWA
 - B. ASME International
 - 1. ASME B16.1 Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 - C. ASTM International
 - 1. A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. A270 Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing.
 - 4. B584 Standard Specification for Copper Alloy Sand Castings for General Applications.
- 1.05 WARRANTY
 - A. Provide warranty as specified in Section 01740 Warranties

PART 2 PRODUCTS

- 2.01 AIR/VACUUM VALVES (SEWAGE SERVICE)
 - A. Manufacturers: One of the following or equal:
 - 1. DeZurik/APCO, ASV-401 Sewage Air/Vacuum Valve.
 - 2. Approved equal.
 - B. Design:
 - 1. The valve shall be specifically designed for operation on sewage or waste media.
 - 2. The valve shall automatically provide the release of large volumes of air during pipeline filling.
 - 3. The valve shall remain closed and not open when the system is full and under positive pressure.
 - 4. The valve shall open under negative pressure to admit large volumes of air during pipeline draining to prevent vacuum.
 - 5. The valve shall release air under pressure without spilling liquid.
 - 6. An air gap shall prevent waste solids from fouling or clogging the top shut-off float.
 - 7. Pressure rating: 150 pounds per square inch.
 - 8. Orifice size: 1/4-inch diameter.
 - 9. Connections: Threaded, 3-inch diameter inlet and threaded, 1/2]-inch diameter outlet.
 - C. Accessories:
 - 1. Inlet eccentric plug shutoff valve.
 - 2. Blowoff valve.
 - 3. Backflushing shutoff valve.
 - 4. Backflush hose with quick disconnect couplings 10 feet.
 - D. Materials:
 - 1. Body: Ductile or cast iron.
 - 2. Float: Type 316 stainless steel.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. All air and vacuum valves shall be installed in strict accordance with the Manufacturer's published recommendation.
 - B. Install air and vacuum valves with appropriate discharge lines routed as shown on the drawings.
- 3.02 FIELD TESTING
 - A. Air and vacuum valves shall be field tested and corrected for any deficiencies.

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This scope covers the furnishing, installation, testing, adjusting and placing in operation all electrical equipment, devices, facilities, materials, and auxiliary items necessary for the complete and successful operation of all electrical equipment as herein described, shown on the plans, or deemed necessary for the completion of the electrical portion of the project. It is the intent of DIVISION 16 to outline the electrical requirements of the contract in order to provide the information necessary for the construction of a fully operational system as shown on the plans and as herein described. A comprehensive electrical scope of work is as follows:
 - 1. Power/Electrical System
 - 2. Lighting System
 - 3. Control System
 - 4. Utility Work
 - 5. Connection of Electrically Powered Mechanical Equipment
 - 6. Temporary Construction Power
 - 7. All Incidentals Necessary for a Complete and Fully Operational Electrical System.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Division 1 General Requirements.
 - 2. Division 15 Mechanical
 - 3. Division 16 Electrical.
 - 4. Division 17 Instrumentation.

1.03 SUBMITTALS

- A. Submit under provisions of the General Provisions.
 - 1. The Contractor installing all Electrical work shall review and approve all electrical shop drawings prior to submittal to the Engineer for review. As part of the review, the installer shall certify the following:
 - a. I hereby certify that the (equipment (material) (article) shown and marked in this submittal is in compliance with the contract drawing and specifications, can be installed in the allocated space, will be stored in accordance with the manufacturer's recommendation, will be installed per NEC, and is submitted for approval.

Certified by: Date:

- B. Shop drawing received without the Certification above will be returned without being reviewed. The Certification must be signed by the Master Electrician in responsible charge of the project.
- C. Submit shop drawings and product data grouped to include complete submittal of related systems, products, and accessories in a single submittal. No electrical work may be performed until shop drawings are approved. Submit Shop Drawings on the Following Systems as Grouped Below:
 - 1. Area Classification
 - a. Provide an NFPA 820 Area Classification Survey for each proposed process area
 - b. Submit the proposed boundary of each classification area
 - c. Submit the proposed raceway sealing methods to be used for passing through each area
 - d. Submittals may be made using CP&Y PDF project drawings as the backgrounds
 - 2. Low Voltage Power/Electrical System
 - a. Conduit and Conduit Fittings
 - b. Wire
 - c. Pull Boxes
 - d. Panelboards
 - e. Panelboard Layouts
 - f. Circuit Breakers
 - g. Disconnects
 - h. Fuses
 - i. Conduit Support Systems
 - j. Wiring Devices
 - k. Transformers
 - I. Surge Protection Equipment
 - m. Motor Starters
 - n. Soft Starts
 - o. Motor Starters
 - p. Equipment Supports
 - 3. Power System Studies
 - a. Prior to Approval of Any Power Equipment
 - (i) Load Flow
 - (ii) Short Circuit
 - (iii) Protective Device Evaluation
 - b. Prior to application of Electrical Power
 - (i) Arc Flash
 - c. After 30 Day Facility Run Test
 - (i) Final Load Flow
 - (ii) Final Short Circuit
 - (iii) Final Protective Device Evaluation
 - (iv) Final Arc Flash

- (v) Final Harmonic Studies
- 4. Lighting System
 - a. All Light Fixtures
 - (i) Computer Printout of Lighting Layout
 - (a) Site
 - (b) All Process Areas
 - (c) All Buildings
 - (ii) Sample Fixture (as directed by Engineer)
 - (iii) IES Photometric Files
 - (iv) Energy Code Analysys
 - b. Light poles and Foundations
- 5. Control System
 - a. Fiber Cable
- 6. Miscellaneous Utility Work
 - a. Power Company Coordination and Ducts
- 7. Miscellaneous Electrical Equipment
 - a. Miscellaneous Electrical Parts
- 8. Drawings
 - a. Coordination drawing of All Electrical Rooms (The purpose if for independent verification. As such the contractor will need to create a new drawing to verify the electrical installation)
 - b. Conduit layout drawings
 - c. Duct drawings
- D. Mark dimensions and values in units to match those specified.
- 1.04 REFERENCE STANDARDS
 - A. ANSI/NFPA 70 National Electrical Code.
 - B. ANSIC2 National Electrical Safety Code.
 - C. ANSI American National Standards Institute
 - D. IBC International Building Code
 - E. IEEE The Institute of Electrical and Electronics Engineers
 - F. IES The Illuminating Engineering Society of North America
 - G. ISA International Society of Automation
 - H. NECA National Electrical Contractor Association
 - I. NEMA National Electrical Manufacturer's Assoc.
 - J. NETA International Electrical Testing Association
 - K. NFPA National Fire Protection Assoc.

- L. OSHA The Occupational Health and Safety Administration of the United States Department of Labor
- M. Recommended Standards for Water Works and Wastewater Facilities as published by Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers.
- N. UL Underwriters Laboratories
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 WORKING CLEARANCES
 - A. Working clearances around equipment requiring electrical services shall be verified by Contractor to comply with Code requirements. Should there be apparent violations of clearances; the Contractor shall notify the Engineer before proceeding with connection or placing of equipment.
 - B. In the case of panelboards, safety switches and other equipment requiring wire and cable terminations, the Contractor shall ascertain that lug sizes and wiring gutters or space allowed for proper accommodation and termination of the wires and cables are adequate.
- 1.11 WORKMANSHIP
 - A. Workmanship under this Division shall be accomplished by persons skilled in the performance of the required task. All work shall be done in keeping with conventions of the trade. Work of this Division shall be closely coordinated with work of other trades to avoid conflict and interference.
- 1.12 PROTECTION OF ELECTRICAL EQUIPMENT
 - A. All electrical equipment and wiring shall be stored in a clean and dry location. The location shall be temperature and humidity controlled. All equipment shall be stored per the equipment manufacturer's published storage requirements and recommendation. The equipment supplier shall verify that the storage location proposed by the contractor is acceptable to the equipment manufacturer. The contractor shall submit documentation proving that the storage location is acceptable to the manufacturer
 - B. All equipment stored outside of the equipment manufacturers published storage guidelines shall be replaced at the contractor expense. The contractor shall provide temperature and humidity monitoring equipment in the storage area as part of the proof of acceptable storage.

- C. One equipment is placed in an electrical room, the room must be temperature and humidity controlled. In addition, the environment must remain clean and dirt free. Doors and temporary AC units must be installed prior to electrical equipment being placed in the rooms. Recording temperature and humidity gauges will be required in all electrical and process areas with electrical equipment once the equipment is placed.
- D. The contractor shall provide monthly storage reports including the temperature and humidity reading for each storage area. The reports shall include 15 minute interval time frame for all temperature and humidity readings.

1.13 UTILITIES

- A. The Contractor shall provide a fully operational electrical service as described in the plans.
 - 1. Arrange with the utility company for the services and install the services in accordance with their requirements, regulations and recommendations.
- 1.14 WARRANTY/EXTENDED WARRANTY
 - A. Per Division 1

1.15 TEMPORARY POWER AND LIGHTS DURING CONSTRUCTION

- A. It shall be the responsibility of the Contractor to provide and maintain adequate temporary power and lighting at all times during construction, so that the various other trades can accomplish their work in a flawless manner. Particular attention will be given to lighting for masonry, drywall, painting, tile work and any other finish work.
- 1.16 MATERIAL STANDARDS
 - A. Material shall be new and comply with standards of Underwriters' Laboratories, Inc., where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, IPCEA or other publications referenced.

1.17 TEST EQUIPMENT

- A. The contractor shall provide all test equipment and supplies deemed necessary by the Engineer at no extra cost to the Owner. All equipment shall have a current certification certificate. These supplies shall include but not be limited to the following: volt meters, amp meters, light meters, watt meters, harmonic distortion test equipment, thermal image camera, high pot test equipment, power quality analyzers, and oscilloscopes.
- B. The test equipment is in addition to any equipment necessary to conduct the testing prescribed in the project documents.
- 1.18 REGULATORY REQUIREMENTS
 - A. Conform to applicable sections of the Building Code and all local rules, regulations and ordinances.
 - B. Electrical: Conform to NFPA 70 & National Electric Safety Code

- C. Obtain permits, and request inspections from authority having jurisdiction.
- D. References listed in Paragraph 1.04, this section.
- 1.19 FINAL INSPECTION AND TESTING
 - A. After the electrical installation is complete, the Contractor shall deliver to the Engineer the following information with his request for final inspection.
 - 1. One set of contract drawings marked to show all significant changes in equipment ratings and locations, alterations in locations of conduit runs, or of any data differing from the contract drawings. This shall include revised or changed panelboard and switchgear schedules.
 - 2. Certificates of final inspection from local authority.
 - 3. A tabulation of all motors listing their respective manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating.
 - B. The electrical work shall be thoroughly tested to demonstrate that the entire system is in proper working order and in accordance with the plans and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. Contractor may be required during final inspection, at the request of the Engineer to furnish test instruments for use during the testing.

1.20 STAFFING

- A. All electrical work shall be performed by workmen skilled in the electrical trade and licensed for the work by the local authority.
- B. A licensed Master Electrician will be required for the issuance of a building permit for constructing, installing, altering, maintaining, repairing, or replacing any electrical wiring, apparatus, or equipment on any voltage level. A licensed Master Electrician or a licensed Journeyman Electrician holding a current license in the state of Texas is required to be on the job site during the performance of any electrical work. Master Electrician shall spend minimum of 4 hrs per week at the job site reviewing work completed.
- C. In addition, the contractor shall provide one Journeyman electrician for every four "Electrical Apprentices" used on the project site.

1.21 PROCESS EQUIPMENT

- A. The electrical contractor is required to read all other equipment specifications contained in these documents and provide all required power and control conductors required by said equipment to allow them to function as described.
- B. All equipment for which power is not specifically indicated on the plans shall be provided with power per the NEC to the nearest panelboard with adequate capacity to serve said equipment as calculated by the NEC.

1.22 COORDINATION DRAWINGS

- A. The contractor shall provide coordination drawings for all electrical rooms.
- B. The drawings shall be used by the contractor to coordinate conduits stub ups for equipment and cable tray routing.
- C. The coordination drawings must be approved prior to installation any below grade conduits associates with a building.
- 1.23 AS-BUILT DRAWINGS
 - A. The contractor shall provide detailed as-built drawings for the project indicating all power wiring. (All Drawings shall be delivered to the Owner in an AutoCAD 2019 Format.)
 - B. The As-Built drawings shall include detailed drawings of all duct banks, underground conduit, above ground conduit, PLC control panels, control drawings. These drawings shall indicate exact location of all underground electrical wiring and fiber optic cable.
 - C. CP&Y will provide electronic copies of all drawings in the bid plans set on a CD for use by the contractor.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section Includes:
 - 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
 - 5. Salvaged items.
 - 6. Protection of items to remain as indicated on Drawings.
 - 7. Relocate existing equipment to accommodate construction.

1.02 RELATED WORK

- A. Division 1 General Provisions
- B. Division 2 Site Work
- 1.03 SUBMITTALS
 - A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.
 - B. Schedule with Project Manager for required shut-downs to accommodate system demolition and installation or temporary facilities.
 - C. Division 1 Requirements for submittals.
 - D. Shop Drawings: Indicate removal sequence and location of salvageable items; location and construction of temporary work. Describe demolition removal procedures and schedule.
 - E. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place.

1.04 REFERENCE STANDARDS

- A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with:
 - American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), Article No. 305 - Temporary Wiring
1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NEC and project specifications
- B. Verify field measurements and circuiting arrangements are as shown on Drawings.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities.
- D. Demolition drawings are based on field observation and existing record documents. Report discrepancies to City Engineer before disturbing existing installation.
- E. By beginning demolition, installer accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the City all items and systems in good operating condition.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 PRE-INSTALLATION MEETINGS
 - A. Division 1 Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.
- 1.11 SCHEDULING
 - A. Division 1 Requirements for scheduling.
 - B. Schedule work to coincide with new construction.
 - C. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.12 COORDINATION

- A. Division 1 Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate demolition work with facility operation.
- D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- E. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in-service panels with Owner and Engineer. Do not shut down any utility without prior written approval.

- 2. Keep shut-down period to minimum or use intermittent period as directed by Owner and Engineer.
- 3. Maintain life-safety systems in full operation in occupied facilities or provide notice minimum 3 days in advance.
- F. Identify salvage items in cooperation with Owner.
 - 1. No Items to be Salvaged by the Owner
- PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- 3.01 EXAMINATION
 - A. Division 1 Verification of existing conditions before starting work.
 - B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
 - C. Verify termination points for demolished services.

3.02 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. Temporary egress signage and emergency lighting
- 3.03 DEMOLITION
 - A. Carefully coordinate Work specified in this Article to avoid duplication in other sections.
 - B. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner/Engineer before disturbing existing installation.
 - C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 - D. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
 - E. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
 - F. Reconnect equipment being disturbed by renovation work and required for continue service to nearest available panel.
 - G. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
 - H. Install temporary wiring and connections to maintain existing systems in service during construction.

- I. Perform work on energized equipment or circuits with experienced and trained personnel.
- J. Remove, relocate, and extend existing installations to accommodate new construction.
- K. Repair adjacent construction and finishes damaged during demolition and extension work.
- L. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- M. Clean and repair existing equipment to remain.
- N. Protect and retain power to existing active equipment remaining.
- O. Cap abandoned empty conduit at both ends.
- 3.04 EXISTING PANELBOARDS
 - A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
 - B. Tag unused circuits as spare.
 - C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
 - D. Remove existing wire no longer in use from panel to equipment.
 - E. Provide new updated directories where more than three circuits have been modified or rewired.
- 3.05 SALVAGE ITEMS
 - A. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner.
 - B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.
- 3.06 REUSABLE ELECTRICAL EQUIPMENT
 - A. Carefully remove equipment, materials, or fixtures which are to be reused.
 - B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
 - C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.
- 3.07 CLEANING
 - A. Division 1 Requirements for cleaning.

- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.
- 3.08 PROTECTION OF FINISHED WORK
 - A. Division 1 Requirements for protecting finished Work.
 - B. Do not permit traffic over unprotected floor surface.

UTILITIES

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. Furnish and install necessary materials and make arrangements for the connection of utilities for the project. The required utilities are electrical and telephone services.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS (NOT USED)
- 1.04 REFERENCE STANDARDS
 - A. Comply with all service installation standards of the serving utility companies.
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)

PART 2 PRODUCTS

- 2.01 ELECTRICAL SERVICE
 - A. The Contractor shall coordinate with Power Company installation of work as shown on the drawings
 - B. Entrance must be coordinated with the Owner's Representative / Owner. Provide materials and equipment required to connect the project service to the system. Coordinate with Electric Company for requirements of power service. All connection costs to be paid by the Owner.

PART 3 EXECUTION

- 3.01 UTILITY
 - A. Contractor to follow the project construction sequencing, electrical equipment shall be energized on time. Delay to the startup shall not be caused due to electrical contractor mis-coordination.

- B. Contractor to minimize interruption of service. Contractor to coordinate with Owner's Representative prior any interruption of electrical service.
- C. All fees required by the electric utility will be paid directly to the utility companies by the Owner.

POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Load Flow, Short Circuit Studies, Protective Device Evaluation Studies, Equipment Evaluation, Arc Flash, and Harmonic Studies, shall be performed by an electrical service firm regularly engaged in power system studies.
- B. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings, and/or prior to release of equipment for manufacture. If formal completion of the studies cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
- C. The studies shall include all portions of the electrical distribution system from the normal power source and generator sources down to, and including, the 120-Volt distribution system, including 208V main 3 phase circuit breaker and all 208V, 1 phase loads. Study shall also include all manufacturer supplied equipment. Normal system connections and those, which result in maximum fault conditions, shall be adequately covered in the study. System showing the largest load or partial list of the equipment on the bus will be rejected. One line diagram shall show all loads on the system. Combined circuits or partial one lines are not allowed. Utility owned transformer protection device shall be included in each power system study.
- D. The engineer performing the study shall certify that all protective devices and relays have been set per the study and submit a letter stating such.
- E. One separate study shall be provided for each lift station facility. Studies for all facilities shall not be combined in one report.
- F. The work associated with this section is to be performed by or under the direction of a professional engineer licensed by the State of Texas.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Qualifications of the professional engineer performing the study and a copy of the professional liability insurance certificate.
 - C. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

- D. The results of the studies shall be summarized in a final report. Provide three (3) bound copies of the complete final report shall be submitted. Provide a PDF copy of the full report including all one line drawings on a three (3) CDs for the owner.
- E. The contractor is required to provide the study project files to the Owner in electronic format.
 - 1. The electronic version shall include the backup folder with all the libraries files.
- F. The report shall include the following sections:
 - 1. Executive Summary.
 - 2. Descriptions, purpose, basis and scope of the study
 - 3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
 - 4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
 - 5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout
 - 6. Details of the incident energy and flash protection boundary calculations
 - 7. Recommendations for system improvements, where needed
 - 8. One-line diagram
 - 9. A letter from utility provider showing available short circuit current at the service entrance, X/R ratios, impedances and characteristics of upstream protective devices.
- G. Arc flash labels shall be provided in hard copy only.

1.04 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - 6. IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

- 4. ANSI C 37.41 Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code, latest edition
 - 2. NFPA 70E Standard for Electrical Safety in the Workplace
- 1.05 QUALITY ASSURANCE
 - A. The studies shall be conducted under the supervision and approval of a Registered/Licensed Professional Electrical Engineer skilled in performing and interpreting the power system studies.
 - B. The Registered/Licensed Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
 - 1. The Engineer shall demonstrate experience with Electrical Studies by submitting names of at least ten actual studies performed in the past two year
 - C. The Registered/Licensed Professional Electrical Engineer shall sign and seal all studies submitted to the Owner/Engineer.
 - D. The equipment manufacturer or approved engineering firm.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 COMPUTER ANALYSIS SOFTWARE
 - A. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program.
- 1.11 PRE-INSTALLATION MEETINGS
 - A. Convene minimum one week prior to commencing work of this section.
- 1.12 SEQUENCING
 - A. Allow 2 weeks for review of completed study by Owner and Engineer.
 - B. Submit short circuit and protective device coordination study to Owner and Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.
 - C. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Owner and Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

- 1.13 SCHEDULING
 - A. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.
- 1.14 COORDINATION
 - A. Coordinate work with local power company.
 - B. Coordinate with all equipment manufacturer's supplying equipment for the project:
 - 1. HVAC
 - 2. Process Mechanical
 - 3. Electrical
- PART 2 PRODUCT
- 2.01 STUDIES
 - A. Contractor to furnish short-circuit and protective device coordination studies as prepared by an approved engineering firm.
 - B. The contractor shall furnish an Arc Flash Risk Assessment Study per NFPA 70E Standard for Electrical Safety in the Workplace, reference Article 130.5 and Annex D.
- 2.02 DATA COLLECTION
 - A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
 - B. Source combination may include present and future motors.
 - C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
 - D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.
- 2.03 LOAD FLOW STUDY
 - A. Verify that the electrical equipment and cabling proposed can support the estimated load flows on the system.
- 2.04 EQUIPMENT EVALUATION STUDY
 - A. Verify that the electrical equipment AIC rating is acceptable based on the equipment X/R ratio.

2.05 HARMONIC ANALYSIS STUDY

A. The evaluate the sizing of the proposed Harmonic and power correction units based on the proposed process and VFD equipment.

2.06 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 - 5. Tabulations of calculated quantities
 - 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - 1. Electric utility's supply termination point
 - 2. Service Entrance Main
 - 3. Manual or automatic transfer switch
 - 4. Panelboards
 - 5. Motor Controllers
 - 6. Disconnect Switches
 - 7. Process Equipment Control Panels
 - 8. Control System Control Panels
 - 9. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of electrical equipment bus bars to withstand short-circuit stresses
 - 3. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.07 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 - 1. Electric utility's overcurrent protective device
 - 2. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - 3. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 - 4. Conductor damage curves
 - 5. Pertinent motor starting characteristics and motor damage points, where applicable
 - 6. The largest feeder circuit breaker in each panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- 2.08 ARC FLASH RISK ASSESSMENT
 - A. The arc flash risk assessment shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.
 - B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
 - C. The Arc-Flash Risk Assessment shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
 - D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
 - E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
 - F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.

- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.09 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:
 - 1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 - 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
 - 3. Reactor data, including voltage rating, and impedance.
 - 4. Generation contribution data, (synchronous generators and Utility), including shortcircuit reactance (X"d), rated MVA, rated voltage, three-phase and single lineground contribution (for Utility sources) and X/R ratio.
 - 5. Motor contribution data (induction motors and synchronous motors), including shortcircuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- B. Short-Circuit Output Data shall include, but not be limited to the following reports:

- 1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Equivalent impedance
- 2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Calculated asymmetrical fault currents
 - (i) Based on fault point X/R ratio
 - (ii) Based on calculated symmetrical value multiplied by 1.6
 - (iii) Based on calculated symmetrical value multiplied by 2.7
 - e. Equivalent impedance
- 3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. No AC Decrement (NACD) Ratio
 - e. Equivalent impedance
 - f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
 - g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis
- C. Recommended Protective Device Settings:
 - 1. Phase and Ground Relays:
 - a. Current transformer ratio
 - b. Current setting
 - c. Time setting
 - d. Instantaneous setting
 - e. Recommendations on improved relaying systems, if applicable.
 - 2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground)
 - b. Adjustable time-current characteristic
 - c. Adjustable instantaneous pickup
 - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and flash protection boundary calculations
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time

- 3. Duration of arc
- 4. Arc flash boundary
- 5. Working distance
- 6. Incident energy
- 7. Hazard Risk Category*
- 8. Recommendations for arc flash energy reduction

*Applicable only when using the arc flash PPE category method.

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

- A. The contractor of the Arc Flash Risk Assessment shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Hazard risk category*
 - 5. Incident energy
 - 6. Working distance
 - 7. Engineering report number, revision number and issue date.

*Applicable only when using the arc flash PPE category method.

- D. Labels shall be machine printed, with no field markings.
- E. Arc flash labels shall be provided on the following equipment and all labels shall be based on recommended overcurrent device settings.
 - 1. Main Breaker
 - 2. ATS
 - 3. Power Panels
 - 4. Pump Starters

- 5. RTUs
- 6. Mechanic Control Panels
- 7. Pump Connection Junction Boxes

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.
- 1.02 RELATED WORK
 - A. Division 3 Concrete
 - B. Division 7 Thermal and Moisture Protection: Firestopping
 - C. Division 16 Electrical
- 1.03 SUBMITTALS
 - A. Division 1 Requirements for submittals.
 - B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
 - C. Product Data:
 - 1. Anchor Systems
 - a. Acceptable base material conditions (i.e. cracked, un-cracked concrete)
 - b. Acceptable drilling methods
 - c. Acceptable bore hole conditions (dry, water saturated, water filled, under water)
 - d. Manufacturer's installation instructions including bore hole cleaning procedures and adhesive injection.
 - e. Cure and gel timetables
 - f. Temperature ranges (storage, installation and in-service).
 - 2. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 3. Firestopping: Submit data on product characteristics, performance and limitation criteria.
 - D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Firestopping Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.
- 1.04 REFERENCE STANDARDS
 - A. ASTM International:
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
 - 5. ASTM E 488-96 (2003); Standard Test Method for Strength of Anchors in Concrete and Masonry Elements, ASTM International.
 - 6. ASTM E 1512-93, Standard Test Methods for Testing Bond Performance of Adhesive- Bonded Anchors, ASTM International
 - B. American Concrete Institute
 - 1. AC308; Acceptance Criteria for Post-Installed Anchors in Concrete Elements, Latest revision.
 - C. FM Global:
 - 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
 - D. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - E. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.
 - F. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH Certification Listings.

1.05 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with local codes and standards.
- G. Maintain one copy of each installation detail on site on site.
- H. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- I. Installer: Company specializing in performing work of this section with minimum 3 years' experience and approved by manufacturer.

1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS

- A. Firestopping Materials: UL Listed to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Firestop interruptions to fire rated assemblies, materials, and components.
- C. Firestopping: Conform to UL Standards for fire resistance ratings and surface burning characteristics.

- D. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01600 Material and Equipment: Requirements for transporting, handling, storing, and protecting products.
 - B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
 - C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 DEFINITIONS
 - A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.
- 1.11 PRE-INSTALLATION MEETINGS
 - A. Division 1 Requirements for Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.
- 1.12 ENVIRONMENTAL REQUIREMENTS
 - A. Section 01600 Material and Equipment: Environmental conditions affecting products on site.
 - B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
 - C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- PART 2 PRODUCTS
- 2.01 CONDUIT SUPPORTS
 - A. Stainless Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers:Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Thomas & Betts Corporation.
 - c. Unistrut; Tyco International, Ltd.

- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiberresin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
 - 1. Manufacturers:Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Unistrut; Tyco International, Ltd.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items shall be stainless steel.
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Stainless Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Manufacturers:
 - 1. Unistrut
 - 2. Substitutions: Division 1 Substitution Requirements.
- G. Hanger Rods: Threaded high tensile strength stainless steel with free running threads.
- H. Beam Clamps: stainless steel, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: stainless steel.
- I. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- J. Conduit clamps general purpose: One-hole malleable iron for surface mounted conduits.
- K. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self-locking.
- 2.02 MOUNTING, ANCHORING, AND ATTCAHMENT
 - A. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-stainless steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- (i) Hilti Inc.
- (ii) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (i) Hilti Inc.
 - (ii) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 3. ADHESIVE ANCHORING SYSTEMS
 - a. Acceptable Manufacturers
 - (i) Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - (a) HILTI HIT-RTZ with HIT-HY 150 MAX.
 - (ii) The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
 - b. Product Description
 - (i) Anchor body with helical cone shaped thread on the embedded end and standard threads on the exposed end, with washer and nut, inserted into Injection adhesive.
 - (ii) No cleaning of dust or water removal shall be required prior to installation of the adhesive and anchor body
 - (iii) All parts shall be manufactured of 316 stainless steel conforming to SAE 316.
- 4. Clamps for Attachment to Steel Structural Elements: Stainless Steel, type suitable for attached structural element.
- 5. Through Bolts: Stainless Steel Structural type, hex head, and high strength.
- 6. Hanger Rods: Threaded stainless steel

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-stainless steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- 2.04 SLEEVES
 - A. Furnish materials in accordance with local codes and standards.
 - B. Sleeves for Electrical Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.
 - C. Sleeves for Electrical Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage (1.2 mm) thick galvanized steel.
 - D. Sleeves for Electrical Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.05 FIRESTOPPING

- A. Manufacturers:
 - 1. 3M
 - 2. Hilti
 - 3. Substitutions: Division 1 Substitution Requirements.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: RED
- PART 3 EXECUTION
- 3.01 EXAMINATION
 - A. Division 1 Verification of existing conditions before starting work.
 - B. Verify openings are ready to receive sleeves.
 - C. Verify openings are ready to receive firestopping.
- 3.02 PREPARATION
 - A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
 - B. Remove incompatible materials affecting bond.
 - C. Install backing materials to arrest liquid material leakage.
 - D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
 - E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.03 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide expansion anchors, powder actuated anchors, or adhesive anchors.
 - 2. Steel Structural Elements: Provide beam clamps, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Install conduit and raceway support and spacing in accordance with NEC.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- D. Install multiple conduit runs on common hangers.
- E. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
 - 4. Support vertical conduit at every floor.

3.04 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Remove dam material if allowed by Firestop manufacturer and UL Listed assembly
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch (25 mm) void between sleeve and building element.
 - c. Pack void with backing material.

- d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- 2. Where cable tray, bus, cable bus, conduit, wireway, and trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch (25 mm) void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and electrical rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Division 3.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed hot dipped galvanized steel channel. Brace and fasten with flanges bolted to structure.
- 3.06 INSTALLATION SLEEVES
 - A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
 - B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
 - C. Set sleeves in position in forms. Provide reinforcing around sleeves.
 - D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
 - E. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.
 - F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

- G. Install stainless steel escutcheons at finished surfaces.
- 3.07 FIELD QUALITY CONTROL
 - A. Division 1 Field inspecting, testing, adjusting, and balancing.
 - B. Inspect installed firestopping for compliance with specifications and submitted schedule.
- 3.08 CLEANING
 - A. Division 1 Requirements for cleaning.
 - B. Clean adjacent surfaces of firestopping materials.
- 3.09 PROTECTION OF FINISHED WORK
 - A. Division 1 Requirements for protecting finished Work.
 - B. Protect adjacent surfaces from damage by material installation.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
 - C. Samples (only required if specifically asked for by the Engineer):
 - 1. Submit two samples of each type of identification products applicable to project.
 - 2. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.
 - D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
 - E. Project Record Documents: Record actual locations of tagged devices; include tag numbers.
- 1.04 QUALITY ASSURANCE
 - A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.
 - B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE
 - A. Division 1 Requirements for transporting, handling, storing, and protecting products.
 - B. Accept identification products on site in original containers. Inspect for damage.
 - C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
 - D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY
 - A. Per Division 1 General Provisions
- 1.10 COORDINATION
 - A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
 - B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
 - C. Coordinate installation of identifying devices with location of access panels and doors.
 - D. Install identifying devices before installing acoustical ceilings and similar concealment.
 - E. Install all signs and labels horizontal (level) and consistent for similar equipment and panels.
- PART 2 PRODUCTS
 - A. NAMEPLATES
 - B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
 - C. Letter Size:
 - 1. 1/4-inch-high letters for identifying grouped equipment and loads.
 - D. Minimum nameplate thickness: 1/8 inch.

2.02 LABELS

- A. In this article, list manufacturers acceptable for this Project.
- B. Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with manufacturers' products specified above.
- C. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background.
- 2.03 WIRE MARKERS
 - A. In this article, list manufacturers acceptable for this Project.
 - B. Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers' products specified above.
 - C. Description: split sleeve or tubing] type wire markers.
 - D. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams by the equipment manufacturer
- 2.04 DESCRIBE LEGENDS REQUIRED FOR OTHER WIRE AND CABLE APPLICATIONS.
- 2.05 CONDUIT AND RACEWAY MARKERS
 - A. In this article, list manufacturers acceptable for this Project.
 - B. Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers' products specified above.
 - C. Description: Nameplate fastened with stainless steel straps.
 - D. Color:
 - 1. 480 Volt System: Black lettering on white background.
 - 2. 208 Volt System: Black lettering on white background.
 - E. Describe requirements for legend for other systems. STENCILS
 - F. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches (50 mm) Outside Diameter of Raceway: 1/2 inch (13 mm) high letters.
 - 2. 2-1/2 to 6 inches (64 to 150 mm) Outside Diameter of Raceway: 1 inch (25 mm) high letters.
 - G. The following are suggestions for colors and background. Edit or revise to meet project conditions.
 - H. Stencil Paint: As specified in Section 09900, semi-gloss enamel, colors conforming to the following:

1. Black lettering on white background.

2.06 UNDERGROUND WARNING TAPE

- A. In this article, list manufacturers acceptable for this Project.
- B. Manufacturers:
 - 1. Brady ID
 - 2. Kolbi Pipe Marker Co.
 - 3. Seton Identification Products
 - 4. Substitutions: Section 01600 Material and Equipment.
- C. Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers' products specified above.
- D. Description: 4 inch (100 mm) wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with snap-around label.
 - 1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
 - 1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
 - 2. Fire Alarm System: Red.
 - 3. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 4. Combined Fire Alarm and Security System: Red and blue.
 - 5. Security System: Blue and yellow.
 - 6. Mechanical and Electrical Supervisory System: Green and blue.
 - 7. Telecommunication System: Green and yellow.
 - 8. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
 - 1. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.

- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape, and identify each ungrounded conductor according to source and circuit number.
 - 1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
 - 1. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
 - 4. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway. During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches above duct. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall. The Contractor shall utilize one color of warning tape to identify electrical and control ducts throughout the plant.
 - 1. Description:
 - a. Permanent, bright-colored, continuous-printed, polyethylene tape.
 - b. Not less than 6 inches wide by 4 mils thick.
 - c. Compounded for permanent direct-burial service.
 - d. Embedded continuous metallic strip or core.
 - e. Printed legend shall indicate type of underground line.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

- 2. Comply with NFPA 70 and 29 CFR 1910.145.
- 3. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- 4. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- 5. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
- 6. Warning label and sign shall include, but are not limited to, the following legends:
 - a. Multiple Power Source Warning: "DANGER ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - b. Workspace Clearance Warning: "WARNING OSHA REGULATION AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- I. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with ENGINEER/OWNER APPROVED instructions where needed for system or equipment operation. Instructions are needed for all equipment unless otherwise noted.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - b. The engraved legend shall be $\frac{1}{2}$ " White letters on Brown face, and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
 - 2. Emergency Operating Instructions: Install emergency operating instruction signs at equipment used for power transfer, safety shutdown, or any other locations requiring operation in an emergency.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - b. The engraved legend shall be $\frac{1}{2}$ "White letters on Red face, and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor and Outdoor Equipment: Use engraved, laminated acrylic or melamine labels, punched or drilled for screw mounting. Identification labels shall have white letters on a dark-gray background. Unless otherwise indicated, provide a

single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high. Mount labels with stainless hardware.

- b. Labels for field mounted equipment shall include the name of the equipment, and the location from which power is feed. (Provide example for review by Owner/Engineer prior to labeling)
- c. Elevated Components: Increase the size of the labels and letters to those appropriate for viewing from the floor.
- 2. Equipment to Be Labeled:
 - a. Identification labeling of some items listed below may be required by individual Sections or by NFPA 70.
 - b. Panelboards, electrical cabinets, and enclosures.
 - c. Access doors and panels for concealed electrical items.
 - d. Electrical switchgear and switchboards.
 - e. Transformers.
 - f. Electrical substations.
 - g. Emergency system boxes and enclosures generators.
 - h. Motor-control centers.
 - i. Disconnect switches.
 - j. Enclosed circuit breakers.
 - k. Motor starters.
 - I. Push-button stations.
 - m. Power transfer equipment.
 - n. Contactors.
 - o. Battery inverter units.
 - p. Battery racks.
 - q. Power-generating units.
 - r. Voice and data cable terminal equipment.
 - s. Television/audio components, racks, and controls.
 - t. Fire-alarm control panel and annunciators.
 - u. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
 - v. Monitoring and control equipment.
 - w. Uninterruptible power supply equipment.
 - x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
 - y. Control systems
 - z. Field mounted control devices
 - aa. Field mounted instruments

3.02 INSTALLATION PRACTICES

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Attach all signs and labels with stainless steel screws or rivets including any auxiliary hardware appropriate or required for the location and substrate.
- D. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes LARGER than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- F. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- 3.03 EXISTING WORK
 - A. Install identification on existing equipment to remain in accordance with this section.
 - B. Install identification on unmarked existing equipment.
 - C. Replace lost labels.
 - D. Re-stencil existing equipment.

ACCEPTANCE TESTING AND CALIBRATION

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. This section provides the guidelines for testing of electrical equipment and cable. This specification does not release the Contractor or vendor from any further testing required for safe commissioning of the equipment. Tests shall be submitted to Engineer/Owner for approval.
 - B. The Contractor shall immediately correct all deficiencies discovered during testing.
 - C. The Contractor to update the protective device settings with the final power system study acceptance.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. The testing result shall be summarized in a final report certified by the testing technician. Report shall be submitted per Division 1 requirement.
 - B. The report shall include the following section:
 - 1. Description, purpose, basis and scope of the work.
 - 2. Field data sheet showing all visual, mechanical and electrical inspection done on the equipment. The data sheet shall show check mark and values of all the testing done, a description of the instrument used for testing.
 - 3. A summary of the deficiency, concern, repairs and recommendation.
 - 4. A table showing the final settings of all the adjustable equipment tested.
 - 5. All the testing values shall be in accordance with the latest NETA standard.
 - C. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the Specifications.
 - D. Submit a letter certifying full and complete compliance with the Specifications, Drawings and other project requirements. The letter shall list any exceptions or deviations from specified requirements, if any and reasons for same. Exceptions or deviation shall also be clearly marked in a separate color in submittals.

1.04 REFERENCE STANDARDS

- A. InterNational Electric Testing Association Standards (NETA) for acceptance testing of Electrical Distribution Apparatus, Latest Revision, and IEEE Publication No. 141, are hereby made a part of this section, unless otherwise modified herein.
- B. Related equipment specification in all section of Division 16.
- C. NETA Maintenance Testing Specifications for electrical power distribution equipment and system (latest edition).
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)

- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 MEASUREMENT AND PAYMENT
 - A. Included in Base Bid.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION
- 3.01 TESTS
 - A. All tests shall be supervised by the Engineer/Owner and the contractor. Contractor shall give a two week notice of all scheduled tests to the Engineer/Owner in writing.
 - B. Contractor shall notify the Engineer/Owner of scheduled dates of electrical equipment installation completion. Equipment testing shall be coordinated at this time by Contractor with Engineer/Owner and appropriate Manufacturer's Representatives.
 - C. Under this specification the Contractor shall perform the electrical tests on specified equipment and as specified under Part 3, Execution. The Contractor shall supply all equipment required to perform all testing responsibilities.

3.02 EXECUTION

- A. PREPARATORY WORK
 - 1. Prior to the testing of any specific piece of equipment, the Contractor shall remove all shipping hardware and inspect for broken or missing parts and proper connections in accordance with the manufacturer's instructions.
- B. Visual and Mechanical Inspection
 - 1. Prior to any electrical testing Contractor shall perform a visual and Mechanical inspection as specified in the latest NETA standard.

3.03 DEVICE

- A. Switches
 - 1. Electrical Tests
 - a. Perform resistance measurements through accessible bolted electrical connections with low-resistance test.
 - b. Perform a contact/pole-resistance test.
 - c. Perform insulation-resistance test on each pole, phase-to-phase and phaseto-ground with switch closed and across each open for one minute. Test voltage shall be in accordance with manufacturer's published data or latest NETA standard.
 - d. Remove a sample of SF6, gas if provisions are made for sampling and test in accordance with latest NETA standard.
 - e. Perform over-potential test across each gas bottle with the switch in the open position in accordance with manufacturer's published data.
- f. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation.
- g. Verify open and close operation for control devices, if applicable.
- B. Panelboards/Switchboards
 - 1. Electrical Tests
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with NETA Standard.
 - b. Measure contact resistance across each switchblade and fuse holder.
 - c. Perform insulation-resistance tests on each pole, phase-to-phase and phaseto-ground with switch closed and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or NETA Standard whichever is more stringent
 - d. Perform an over-potential test on each pole with switch closed. Test each pole-to-ground with all other poles grounded. Test voltage shall be in accordance with manufacturer's published data or NETA Standard whichever is more stringent
 - e. Measure fuse resistance.
 - f. Verify cubicle space heater operation.
- C. Transformers Dry-type
 - 1. Small Transformers: Dry-Type, Air-Cooled (600 Volt and Below) (less than 100 kVA single-phase or 300 kVA three-phase)
 - a. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.
 - b. Thoroughly clean unit prior to making any tests.
 - c. Perform insulation-resistance test. Calculate polarization index. Measurements shall be made from winding-to-winding and windings-toground. Test voltages and minimum resistance shall be in accordance with NETA Standard. Results to be temperature corrected in accordance with NETA Standard.
 - d. Verify that the transformer is set at the specified tap.
- D. Cables low-voltage, 600V maximum
 - 1. Electrical Tests
 - a. Perform resistance measurements through bolted connections with lowresistance ohmmeter, if applicable, in accordance with latest NETA standard.
 - b. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.
 - c. Perform continuity tests to insure correct cable connection.

- E. Surge Arresters, Surge Protection Devices(Low and Medium Voltage):
 - 1. Electrical Tests
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with NETA Standard.
 - b. Perform an insulation-resistance test at voltage levels in accordance with NETA Standard.
 - c. Test grounding connection in accordance with NETA Standard.
- F. Circuit Breakers Air, Insulated Case/Molded Case
 - 1. Electrical Tests
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with latest NETA standard.
 - b. Perform insulation-resistance tests on each pole, phase-to-phase and phaseto-ground with the circuit breaker closed and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or latest NETA standard.
 - c. Perform a contact/pole-resistance test.
 - d. Perform adjustments for final setting in accordance with coordination study.
 - e. Determine long-time pickup and delay by primary current injection.
 - f. Determine short-time pickup and delay by primary current injection.
 - g. Determine ground-fault pickup and time delay by primary current injection.
 - h. Determine instantaneous pickup by primary current injection.
 - i. Perform minimum pickup voltage test on shunt trip and close coils in accordance with latest NETA standard.
 - j. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
 - k. Verify operation of charging mechanism.
- G. Grounding Systems
 - 1. Electrical Tests
 - a. Perform fall-of-potential test or alternative per IEEE Standard No. 81-1991 on the main grounding electrode or system.
 - b. Perform point-to-point test to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes.
- 1.02 RELATED WORK
 - A. Division 16 Electrical
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirement.
 - B. Product Data: Submit catalog data showing specified features of standard products.
 - C. Product Data: Submit for the following:
 - 1. Rigid Aluminum Conduit
 - 2. EMT Conduit
 - 3. Galvanized Rigid Steel
 - 4. Stainless Steel
 - 5. PCV Coated Galvanized Rigid Steel
 - 6. PVC Sch 40
 - 7. PVC Sch 80
 - 8. Liquid Tight Flexible Nonmetallic Conduit.
 - 9. Raceway / Conduit fittings and bodies
 - 10. Wireways
 - 11. Above grade pull and junction boxes.
 - D. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
 - E. For the following raceway components.Include plans, elevations, sections, details, and attachments to other work.
 - 1. For handholes and boxes for underground wiring, including the following:
 - 2. Duct entry provisions, including locations and duct sizes.
 - 3. Frame and cover design.
 - 4. Grounding details.
 - 5. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - 6. Joint details.

- F. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and other features in the paths of conduit groups with common supports.
- G. Division 1 General Conditions
- H. Project Record Documents:
 - 1. Record actual routing of conduits in yard using GPS technology. Provide a Auto-CAD as-built drawing as part of closeout documentation.

1.04 REFERENCE STANDARDS

- A. American National Standards Institute:
 - 1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 Aluminum Rigid Conduit (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS
 - A. Minimum Raceway Size: 1" unless otherwise specified.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Division 1 Product storage and handling requirements.
 - B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
 - C. Protect PVC conduit from sunlight.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)

- 1.10 COORDINATION
 - A. Division 1 Coordination and project conditions.
 - B. Coordinate installation of in slab outlet boxes.
 - C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.
- PART 2 PRODUCTS
- 2.01 CONDUIT
 - A. PVC Coated Rigid Aluminum Conduit
 - PVC coated rigid aluminum conduit shall have a minimum 0.040-in thick, polyvinyl chloride coating permanently bonded to rigid aluminum conduit and an internal chemically cured urethane or enamel coating. Rigid aluminum conduit shall be as manufactured by the Allied Tube and Conduit Corp.; Wheatland Tube Co.; Triangle PWC Inc. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap. PVC coated conduit and fittings shall be as manufactured by Perma-Cote, Robroy Industries, Triangle PWC Inc. or Ocal.
 - 2. Elbows and couplings shall be PVC coated by the same manufacturer supplying the conduit PVC coating system. Elbows and couplings used with PVC coated conduit shall be furnished with a PVC coating bonded to the aluminum, the same thickness as used on the coated aluminum conduit.
 - B. Rigid Nonmetallic Conduit
 - PVC conduit shall be rigid polyvinyl chloride schedule 40 as manufactured by Carlon; An Indian Head Co.; Kraloy Products Co., Inc.; Highland Plastics Inc. Thinwall conduit designated for encased burial as (Type EB) is not acceptable for any application.
 - C. Liquidtight Aluminum Flexible Metal Conduit
 - Liquidtight aluminum flexible metal conduit shall have an interlocked aluminum core, PVC jacket rated for 80 degrees C., meets NEC Article 351, UL 360 as manufactured by Ultratite AEF by Southwire, the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co.; ALFLEX.
 - 2. Fittings used with liquidtight flexible aluminum conduit shall be extruded from 6063 alloy in temper designation T-1 with maximum 0.1% copper content and shall conform to FEDSPEC WW-C-540C ANSI C80.5, and UL-6.
 - D. Aluminum Flexible Metal Conduit
 - Aluminum flexible metal conduit shall have an interlocked aluminum core, meeting NEC Article 348, UL 1and Federal Specification WW-C-566C, as manufactured by Southwire Alflex, the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co.
 - 2. Fittings used with aluminum flexible metal conduit shall be extruded from AA 6063 alloy in temper designation T-1 and shall conform to FEDSPEC WW-C-540C ANSI C80.5, and UL-6.

- E. Rigid Aluminum Conduit
 - Rigid Aluminum conduit shall be extruded from AA 6063 alloy in temper designation T-1 and shall conform to FED Spec WW-C-540C, ANSI C80-5 and UL-6. Rigid aluminum conduit shall be as manufactured by Wheatland Tube Company, or Allied.
- F. PVC Schedule 40 Conduit
 - Schedule 40 PVC Rigid Nonmetallic Conduit (RNC) shall be designed for use above ground and underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2, Federal Specification WC1094A and UL 651 specifications. Fittings shall be manufactured to NEMA TC-3, Federal Specification WC1094A and UL 514B. Conduit shall have a UL Label. Conduit shall be Carlon, or Kraloy.
- G. PVC Schedule 80 Conduit
 - Schedule 80 PVC Rigid Nonmetallic Conduit (RNC) shall be designed for use above ground and underground as described in the NEC, resistant to sunlight. The conduits and fittings shall be manufactured to NEMA TC-2, Federal Specification WC1094A and UL 651 specifications. Fittings shall be manufactured to NEMA TC-3, Federal Specification WC1094A and UL 514B. Conduit shall have a UL Label. Conduit shall be Carlon, or Kraloy.
- 2.02 BOXES
 - A. Boxes specified herein are for use with raceway systems only. Boxes used for housing electrical and instrumentation equipment shall be as described elsewhere in these Specifications.
 - B. NEMA 1 Areas (indoor air-conditioned): NEMA 1 terminal boxes, junction boxes, pull boxes, etc, shall be of sheet or cast aluminum for wall mounting, or have mounting feet where self-standing. Boxes shall have continuously welded seams. Welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. All boxes shall have hinged, gasketed doors with quarter-turn latches or a 3-point latch (single operator) system on enclosures larger than 36 inches wide or 32 inches tall. Terminal boxes shall be furnished with terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20A. 600V. Boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Boxes shall be Concept Series as manufactured by Hoffman Engineering Co.
 - C. NEMA 4X Areas (outdoor): NEMA 4X terminal boxes, junction boxes, pull boxes etc, shall be Type 316 stainless steel for wall mounting, or have mounting feet where self-standing. Boxes shall have continuously welded seams. Welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. All boxes shall have hinged, gasketed doors with quarter-turn latches or a 3-point latch (single operator) system on enclosures larger than 36 inches wide or 32 inches tall. Terminal boxes shall be furnished with terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20A., 600V. Boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Boxes shall be Concept Series as manufactured by Hoffman Engineering Co.

- D. NEMA 7 Areas (As defined by the NEC): Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations, and shall also have O-ring seals to meet NEMA 4 requirements. Boxes shall be aluminum, with stainless steel hinged covers and stainless steel bolts; Type EJB-N4 as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Adalet-PLM.
- E. Boxes for use in Chlorine and Caustic areas shall be of rigid PVC. Construction shall be the same as specified for NEMA 4X terminal boxes, junction boxes, pull boxes etc. as specified above.
- F. Malleable iron boxes shall not be used.
- 2.03 CONDUIT HUBS
 - A. Conduit hubs for use on raceway system pull and junction boxes shall be watertight aluminum, insulated throat, gasketed, with grounding screw, as manufactured by O-Z/Gedney, or Red-Dot.
 - B. Conduit hubs for use on outlet boxes or boxes containing electrical or instrumentation equipment shall be watertight, threaded aluminum, grounding screw type, insulated throat, hub of female-female type, with locking nipple of male construction. Hubs shall be T&B HTGZ. Hubs with female locking nipples, where the hub projects into the box, will not be acceptable.
- 2.04 CONDUIT SEALS
 - A. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co. type WSK.
 - B. Conduit wall seals for cored holes shall be type CSML-XXXA as manufactured by the O.Z./Gedney Co.
 - C. Conduit wall and floor seals for sleeved openings shall be type CSMI-XXXA as manufactured by the O.Z./Gedney Co.
 - D. Conduit sealing bushings shall be aluminum O.Z./Gedney Type CSBA Series.
- 2.05 EXPANSION-DEFLECTION FITTINGS
 - A. Combination expansion-deflection fittings embedded in concrete, or exposed, with internal grounding, 4" movement, shall be stainless steel/cast iron, Type XJGD as manufactured by the Crouse-Hinds Co.
- 2.06 EXPANSION FITTINGS
 - A. Expansion fittings shall be aluminum, 8" movement, Type XJGSA as manufactured by Crouse-Hinds Co., with internal grounding.
- 2.07 EXPLOSION-PROOF FITTINGS
 - A. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co.

2.08 KELLEMS GRIPS

- A. Kellems grips to support cables shall be of 316 stainless steel.
- 2.09 CONDUIT MOUNTING EQUIPMENT
 - A. All pull and junction box supports, spacers, conduit support rods, clamps, hangers, channel, nut, bolts, washers, etc. and shall be of 316 stainless steel.
- 2.10 WIREWAYS
 - A. All wireways shall be constructed of NEMA 4X 316 stainless steel, with gasketed hinged covers and stainless-steel screws. Wireway shall be as manufactured by Hoffman
- PART 3 EXECUTION
- 3.01 RACEWAY APPLICATIONS
 - A. Unless exact locations are shown on the Drawings, the Contractor shall coordinate the placement of conduit and related components with other trades and existing installations
 - B. Unless shown on the drawings or specified otherwise, the conduit type installed with respect to the location shall be as follows

Conduit Type	Location
1.Rigid Galvanized Conduit	Air Conditioned Spaces.
2.Stainless Steel	All embedded conduit bends (except under- ground duct banks) and all conduit stub- ups to a minimum of 6" above finished floor or grade.
3.Liquidtight Flexible Aluminum Conduit	Raceway connection to vibrating equipment only in all areas. Maximum of 6' length.
4. Rigid Non-metallic, Schedule 40 PVC Conduit	Underground encased in red dyed reinforced concrete.
5. Rigid Non-metallic, Schedule 80 PVC Conduit	For use only in Chemical Areas.
6.Flexible Aluminum Conduit	Fixture whip connection to lighting fixtures in NEMA 1 areas (maximum 3-ft). BX or AC type prefabricated cables are not permitted.
7.Aluminum Rigid Metal Conduit	All above areas, except for concrete embedded and those areas described in Locations 2 through 6 above.

Conduit Type	Location
8.EMT	Admin Building only.

- C. All conduit of a given type shall be the product of one manufacturer.
- 3.02 BOX APPLICATIONS
 - A. Boxes installed in dry areas may be of NEMA 1 aluminum construction. All other boxes shall be of Type 316 stainless steel.
 - B. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast aluminum.
 - C. Junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.
 - D. Where the raceway system connects to junction and pull boxes in a NEMA 1 area, double locknut (one outer and one inner) plus insulated bushing.
 - E. All boxes shall be provided with factory mounting lugs. Drilling through the back of any box or enclosure is prohibited, and if so installed shall be removed and replaced, with no increase in the Contract Price or Construction Schedule.
 - F. The Contractor shall be responsible for sizing all junction boxes and pull boxes in accordance with the National Electrical Code, Article 314 and relevant sections of the NEC.
 - G. Penetrations into the top of NEMA 4X and NEMA 7 boxes shall not be allowed.
 - H. Exposed pull boxes or junction boxes installed outdoors, per NEMA 250 shall be NEMA 4X weatherproof and shall be provided with watertight gasketed covers fastened with stainless steel screws and be 316 stainless steel. All hardware shall be 316 stainless steel. Boxes shall be provided with integral mounting lugs.
 - I. NEMA 1 boxes shall be provided for Air Conditioned spaces only, NEMA 7 for Class 1, Group D, Division 1 hazardous locations and NEMA 4X 316 stainless steel for all other locations.

3.03 FITTINGS APPLICATIONS

- A. Combination expansion-deflection fittings shall be installed where conduits cross structure expansion joints, on conduit transitions from underground to above ground, and where installed in exposed conduit runs such that the distance between expansion-deflection fittings does not exceed one hundred fifty (150) feet of conduit run.
- B. On exposed conduit transitions from underground to above ground, where the earth has been disturbed to a depth of more than ten (10) feet, an expansion fitting, with a minimum of 6" available movement, shall be installed on the exposed side of the transition, in lieu of a combination expansion-deflection fitting.

3.04 CONDUIT SEALS APPLICATIONS

- A. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.
- B. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.
- 3.05 INSTALLATION
 - A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
 - B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 - C. Complete raceway installation before starting conductor installation.
 - D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
 - E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
 - F. No conduit smaller than 1-in electrical trade size, shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required or as directed
 - G. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.
 - H. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction. Duxseal, or 3M seal spray shall be used in all applications. Plugging with tape is prohibited, even for a temporary time.
 - I. Where raceways enter or leave the raceway system where the raceway origin or termination, could be subjected to the entry of moisture, rain or liquid of any type, particularly where the termination of such raceways terminate in any equipment, new or existing at a lower elevation, such raceways shall be tightly sealed at the higher elevation, both before and after the installation of cables, such that there shall be no entry of water or moisture to the Raceway System at any time. Any damage to new or existing equipment shall be corrected by complete replacement of such equipment, at no cost to the Owner. Cleaning or drying of such equipment will not be acceptable.
 - J. Conduit supports, other than for underground raceways, shall be spaced at intervals of 8-ft or less, as required to obtain rigid construction.
 - K. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

- L. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.
- M. All conduits on exposed work shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.
- N. Conduit terminating in boxes and enclosures, other than NEMA 1 type, shall be terminated with conduit hubs.
- O. Conduits terminated into enclosures shall be perpendicular to the walls where flexible liquidtight or rigid conduits are required. The use of short sealtight elbow fittings for such terminations will not be permitted.
- P. Conduits containing equipment grounding conductors and terminating in boxes shall have insulated throat grounding bushings. The wire shall be grounded to the box.
- Q. Conduits shall be installed using threaded fittings. Running threads will not be permitted.
- R. All conduit fittings on PVC conduit shall be of the glued type.
- S. Liquidtight flexible aluminum conduit shall be used for the primary and secondary of transformers, generator terminations and other equipment where vibration is present. Use in other locations is not permitted. Liquidtight flexible aluminum conduit shall have a maximum length not greater than that of a factory manufactured long radius elbow of the conduit size being used. The maximum bending radius shall not be less than that shown in the NEC Chapter 9, Table 2, "Other Bends". BX or AC type prefabricated cables will not be permitted.
- T. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.
- U. Conduit ends exposed to the weather or corrosive gases shall be sealed with conduit sealing bushings.
- V. Raceways terminating in Control Panels, or boxes containing electrical equipment, shall not enter from the top of the panel or box, and the raceway shall be sealed with a removable silicone sealant.
- W. All conduits from external sources entering or leaving a multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer designated area, directly below the vertical section in which the conductors are to be terminated. Conduits entering from cable tray shall be stubbed into the upper section.
- Conduit sealing and drain fittings shall be installed in areas designated as NEMA 4X or
 7.
- Y. A conduit identification plate shall be installed on all power, instrumentation, alarm and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into conduits. Exact

identification plate location shall be coordinated with the Owner/Engineer at the time of installation to provide uniformity of placement and ease of reading. Conduit numbers shall be exactly as shown on the Drawings.

- Z. Conduits noted as spare shall be capped or plugged at both ends with easily removable fittings.
- AA. Mandrels shall be pulled through all existing conduits that will be reused and through all new conduits 2-in in diameter and larger prior to installing conductors.
- BB. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.
- CC. All conduit that may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc, shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits at the point of attachment to the equipment.
- DD. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of the NEC.
- EE. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.
- FF. The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used.
- GG. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal," as manufactured by Mans-ville or 3M, or seal fitting to prevent the accumulation of condensation.
- HH. Conduits shall be located a minimum of 3-in from steam or hot water piping.Where crossings are unavoidable, the conduit shall be kept at least 1-in from the covering of the pipe crossed.
- II. Conduits terminating at a cable tray shall be supported independently from the cable tray.
- JJ. Provide a conduit support within 1-ft of the cable tray. The weight of the conduit shall not bear on the cable tray.
- KK. Penetrations by conduit, raceways, cables, sleeves, etc., through rated walls, shafts, floors, ceilings, etc., shall be sealed by a closure foam, Dow Corning 3-6548 Silicone RTV, GE RTV 35D Silicone Foam.
- 3.06 EXISTING WORK
 - A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
 - B. Remove concealed abandoned raceway to its source.

- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

WIREWAYS

PART 1 GENERAL

- 1.01 WORK INCLUDED
 - A. Furnish labor, materials, equipment and incidentals necessary to install a complete wireway system. Electrical work shall be in accordance with Section 16000 General Provisions. Contractor shall size wireways in accordance with the National Electrical Code.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 1. Wireways
- 1.04 REFERENCE STANDARDS (NOT USED)
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY
 - A. Base warranty per Division 1 General Requirements.
- PART 2 PRODUCT

2.01 MATERIALS

- A. WIREWAY: Provide as manufactured by Hoffman.
- B. WIREWAY ENCLOSURES, SUPPORTS AND ASSOCIATED FITTINGS: NEMA 1 (metallic) for Air Conditioned spaces and NEMA 4X, 304 stainless steel for all other locations, lay-in wireway, quick release cover stainless steel latches, continuously welded seams, oil resistant gasket. Hoffman Lay-In-Type NEMA 1 or NEMA 4X wireway. Factory ANSI 61 gray finish for NEMA 1. NEMA 1 for Air Conditioned spaces and NEMA 4X, 304 stainless steel for all other locations.
- 2.02 FABRICATIONS
 - A. WIREWAYS: Complete wireway system with enclosures, supports, and associated fittings, having the form and dimension suited to the application, and as manufactured by Hoffman.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide systems of wireways of sufficient size where indicated.
- B. Size wireway cross-sectional area and length based upon conductor fill and equipment served as required by NEC and local codes.
- C. Install types based on environmental conditions to which exposed.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. Furnish labor, materials, equipment and incidentals necessary to install 600 volt wires and cables. Electrical work shall be in accordance with Division 16 Electrical.
 - B. Work shall include building wire, cable, wiring connections and terminations, and modular wiring systems.
- 1.02 RELATED WORK
 - A. Division 16 Electrical
- 1.03 SUBMITTALS
 - A. Submittals shall be in accordance with Division 1 General Provisions and Division 16 - Electrical and shall include:
 - B. Product Data: Submit for wire and each cable assembly type.
 - C. Project Record Documents: Record actual locations of components and circuits.
- 1.04 REFERENCE STANDARDS
 - A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - B. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
 - C. National Electrical Manufacturers Association:
 - 1. NEMA WC-3Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 2. NEMA WC-5Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - D. Underwriters Laboratories, Inc.:
 - 1. UL 1277 Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
- 1.05 QUALITY ASSURANCE
 - A. Perform Work in accordance with State and Local codes and standards; NEC, and project specifications.

- B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS
 - A. Product Requirements: Provide products as follows:
 - 1. Supply Stranded conductor for all feeders and branch circuits.
 - 2. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
 - B. Wiring Methods: Provide the following wiring methods:
 - 1. For all Raceway Locations: Use only Type XHHW-2 insulation in raceways.
 - 2. Office Locations: THHN/THWN insulation in raceways.
 - 3. Cable Tray Locations: Use only Tray cable Type TC or XHHW-2 for individual conductors as permitted by the NEC.
 - 4. All VFDs shall be supplied with VFD rated cable
 - 5. All Control Cables shall have on overall shield and be grounded
 - 6. All 4-20mA cable shall be #16AWG Twisted Shielded Pair
 - 7. Ground Wire used as a counterpoise shall be bare tinned copper
 - C. Ground Conductors
 - Conduits and other raceway shall contain an equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly grounded in accordance with National Electric Code requirements. Where ground wire is exposed to mechanical damage, install wire in rigid aluminum conduit. Make connections to equipment with solderless connections. Wire connections to the ground rods of the ground mat shall be of the fused type equal to the Cadweld process.
 - D. Conductor sizes are based on copper.
 - E. Aluminum conductors are not permitted
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 COORDINATION
 - A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
 - B. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 PRODUCTS

A. CONDUCTORS: Soft-drawn, annealed copper with a conductivity of not less than that of 98% pure copper bearing the U.L. label. The minimal size shall be #12. Conductors #8 or larger shall be stranded. Utilize single conductors.

- B. SINGLE CONDUCTORS: Conductor with thermoplastic insulation rated at 600 volts and insulated with type XHHW-2 insulation. Wire shall be water tank tested and approved as machine tool wire, in accordance with National Machine Tool Builders Association. Wire in light fixture channels and other special locations shall be as specifically noted for temperature in NEC Article 300. Wire shall be manufactured by Okonite, Southwire, Encore Wire, or General Cable.
- C. GROUND WIRE: Bare or Tinned, Class B stranded conductor without insulation. Ground wire installed above ground shall be tinned, below ground shall be bare.
- D. PAIRED SHIELDED CABLE: 18 gauge, 7/28 stranded, tinned copper conductors with .015" extruded PVC; .004" nylon insulation twisted into pairs, stranded into a core and enclosed by a non-hygroscopic core tape, 100% coverage, helically wound, aluminum foil shield, drain wire, and .045" minimum extruded PVC jacket. Pairs shall be black/red or black/white numbered. Cables shall be 600 volts in accordance with NEC-725 and IEEE 383. Cables shall be manufactured by Belden, Okonite, Alpha or General Cable.
- E. TRIAD SHIELDED CABLE (RTD CABLE): RTD cable shall have the following characteristics:
 - 1. Eight (8) triads each with three (3) 18 AWG conductors.
 - 2. Triads shall each have individual shield and overall shield.
 - 3. Each conductor insulated for 600V and entire cable rated for 90 deg C.
 - a. Primary Insulation: 15 mils nominal; PVC; 4 mils nylon
 - b. Number of Conductors: 3
 - c. Color Code: Black and white and red
 - d. Group Identification: Each triad numbered
 - e. Pair Shield: 100% coverage; .35 mil aluminum x .5 mil Mylar tape and 20 gauge 7 strand tinned copper drain wire; shield tape to be applied to give a total shield isolation from all other triad shields.
 - f. Cable Shield: 100% coverage; 2.35 mil aluminum Mylar tape shield and an 18 gauge 7 strand tinned copper drain wire.
 - g. Jacket: Black 90 deg C FR PVC
 - h. RTD cable shall be manufactured by Okonite, Belden, or General Cable.
- F. TRAY CABLE: Type TC; multi-conductor cable specifically approved for the installation of cable trays, in accordance with NEC Article 340. Cable shall be Okonite, Southwire, Encore Wire, or General Cable. Each cable conductor shall be insulated with XHHW-2 type insulation rated at 600 volts. The individual conductors shall be twisted together and jacketed with a PVC outer covering containing a U.L. label and necessary identification, including the Manufacturer, the number of conductors, size, XHHW-2 conductors, sun-resistance, and other pertinent information.

2.02 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or]as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.04 INSTALLATION

- A. Unless necessary for pulling purposes, conductors shall be continuous from terminal block to terminal block without splice. Condulet type fittings shall not contain splices. No splicing of conductors shall be performed in any below ground structure.
- B. Splice only in junction or outlet boxes. Neatly train wiring inside boxes, equipment and panelboards. Pull conductors into a raceway at the same time and use U.L. listed, wire pulling lubricant for pulling No. 4AWG and larger wire. Install raceway first as a complete system without conductors. Do not install pull wires and conductors until the raceway system is in place.
- C. Circuits shall be tagged at terminations (both ends), in pull boxes, cabinets, and enclosures as follows:
 - 1. Tags relying on adhesives or taped-on markers are not acceptable.
 - 2. Provide conductor tags for conductors No. 10 AWG and below with legible permanent sleeve of yellow or white PVC with machine printed black marking, Raychem TMS sleeves.
 - 3. Provide tags for cables and for conductors No. 8 AWG and larger consisting of permanent nylon marker plates with legible designations hot stamped on the plate.

Attach these marker plates to conductors and cables with plastic wire wraps. Tags shall be Raychem TMS-CM cable markers.

- 4. Tags shall be imprinted with panelboard and panelboard position number (e.g. LA3-23) for conductors fed from panelboards. Other conductors shall have tags imprinted with the MCC which feeds the conductors (e.g. MCC 1).
- Switchlegs shall have the designation described above on their tags, plus an "S" suffix. Travelers shall have the designation described above on their tags, plus a "T" suffix.
- 6. Where more than one neutral is present with a group of conductors, a tag shall be applied to each neutral indicating which phase conductors are served by each neutral (e.g. HA-2, 4, 6).
- D. Wire other than telephone station wire shall be stranded. The minimum size conductor permitted is #12 AWG, except as specifically indicated on the plans. Wire shall bear the approval of Underwriter's Laboratories, Inc. Conductors terminated on a screw termination shall have a crimp on type spade connector applied on the wire end, Panduit Pan-Term.
- E. Grouping conductors together into one conduit shall not be allowed where the plans indicate the conductors to be placed in separate conduits. Each home run shown on the plans shall be in its own conduit.
- F. Route wire and cable to meet Project conditions.
- G. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- H. Identify and color code wire and cable under provisions of Division 16. Identify each conductor with its circuit number or other designation indicated.
- I. Special Techniques--Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- J. Special Techniques Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- K. Special Techniques Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

- 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- 7. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- 8. PAIRED SHIELDED AND TRIAD SHIELDED CABLE: Ground paired shielded and triad shielded cables at the instrument panel end only and insulate from ground elsewhere. The shield shall be continuous for the entire run. The paired shielded and triad shielded cable shall not be laced with or placed in the same conduit with power cables. Each termination of paired shielded or triad shielded cable shall be coated with silicone jelly after termination. The shield of pair shielded cable and triad shielded cable shall only be broken when the conductors are terminated on terminal strips.
- L. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- M. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- N. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- O. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.
- 3.05 WIRE COLOR
 - A. Color coding of cables shall comply with the local city codes. In the absence of a local color coding requirement, the following shall be used:
 - 1. For 480Y/277V, 3-phase wiring:
 - a. Phase A Brown
 - b. Phase B Orange
 - c. Phase C Yellow
 - d. Neutral Gray
 - e. Equipment Grounding Conductor Green
 - 2. For 208Y/120V or 240/120V, 3-phase wiring:
 - a. Phase A Black
 - b. Phase B Red
 - c. Phase C Blue
 - d. Neutral White
 - e. Equipment Grounding Conductor Green
 - 3. For 120/240V, 1-phase wiring:
 - a. Leg A Black
 - b. Leg B Red
 - c. Neutral White
 - d. Equipment Grounding Conductor Green

- B. Colored, vinyl marking tape shall be allowed only on conductors greater than 8 AWG. Under no condition shall conductors of a different color be spliced together.
- C. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- D. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- E. Feeder Circuit Conductors: Uniquely color code each phase.
- F. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.
- 3.06 GROUND CONDUCTORS
 - A. Conduits and other raceway shall contain an equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly grounded in accordance with National Electric Code requirements. Where ground wire is exposed to mechanical damage, install wire in rigid aluminum conduit. Make connections to equipment with solderless connections. Wire connections to the ground rods of the ground mat shall be of the fused type equal to the Cadweld process.
 - B. Ground metallic material, including but not limited to metallic raceway, metallic boxes and metallic enclosures. Where metallic material is not connected by raceway to a solid ground, connect the metallic material to the largest equipment grounding conductor which it houses. Clean the metal surface under the grounding lug to bright metal. Connections to motors shall be to the grounding stud which shall be threaded into the stationary frame; Burndy KC Servit, and not an end bell. The ground wire shall not be lugged to a mounting bolt.
 - C. Ground wire shall be uninsulated tinned copper sized as shown on the plans in all cases where a single ground wire is indicated to be installed in a conduit with no other conductors in the conduit, or where the ground wire is directly buried in earth or concrete. In all other cases, insulate ground wire with insulation as specified for low voltage wire.
- 3.07 FIELD QUALITY CONTROL
 - A. Inspect and test in accordance with NETA ATS.

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install outlet boxes, floor boxes, junction boxes, pull boxes and terminal boxes.
- B. All boxes located outdoors containing heat sensitive equipment shall be factory painted white.
- 1.02 RELATED WORK
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Division 1 General Provisions.
 - 2. Division 16 Electrical.

1.03 SUBMITTALS

- A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
- B. Submittal shall be clearly marked showing only equipment provided. Mark through equipment option not provided.
- C. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the Specifications.
- D. Submit a letter certifying full and complete compliance with the Specifications, Drawings and other project requirements. The letter shall list any exceptions or deviations from specified requirements, if any and reasons for same. Exceptions or deviation shall also be clearly marked in a separate color in submittals.

1.04 REFERENCE STANDARDS

- A. ANSI/NEMA Publication No. OS 1 Cast Aluminum Outlet Boxes, Device Boxes, Covers and Box Supports, and Steel Covers.
- B. ANSI/UL 514 Electrical Outlet Boxes and Fittings.
- C. NFPA 70 National Electric Code.
- 1.05 QUALITY ASSURANCE
 - A. The general construction of the boxes and the materials used shall be similar to that used for boxes of the same size and rating in continuous production for at least 15 years

and successfully operating in the field in substantial quantities.

Upon request, the manufacturer shall submit a copy of his Quality Assurance Manual detailing the quality control and quality assurance measures in place at his facility.

- B. The manufacturer shall have available for audit detailed descriptions of the method by which his various manufacturing processes and production test are recorded, thus enabling the "traceability" of the boxes. All steps in the manufacturing process, from receipt of raw material to the final tests, are to be included. Where multiple records are used, the method for cross-referencing shall be noted.
- 1.06 SYSTEM DESCRIPTION / DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE
 - A. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document shall be provided with the equipment at time of shipment.
 - B. Enclosures shall be stored in the original cartons in a favorable environment (cool and dry areas).
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 EXTENTED WARRANTY
 - A. Base warranty per Division 1 General Provisions.
- PART 2 PRODUCTS
- 2.01 MATERIALS
 - A. Outlet Boxes
 - 1. Flush Device Boxes:
 - a. Provide cast aluminum boxes of sufficient size to accommodate wiring devices to be installed at outlet.
 - b. Extension rings shall not be acceptable.
 - c. Square or rectangular boxes may be supplied.
 - d. Unless otherwise noted, provide boxes 3-1/2-inches deep by 4 inches wide.
 - e. Boxes in hazardous locations shall be NEMA rated for the application.
 - f. Boxes in contact with masonry or concrete shall be gray steel.
 - 2. Exposed Device Boxes: Provide FD aluminum boxes for surface mounting in areas having exposed conduit systems. Provide gray steel boxes in areas in contact with masonry or concrete. Coordinate box cover for proper use.
 - 3. Boxes for Lighting Fixtures:
 - a. Provide aluminum octagonal boxes with fixture stud supports and attachments as required to properly support ceiling and bracket-type lighting fixtures.
 - b. Unless otherwise noted, provide boxes 2 inches deep by 4 inches wide.
 - c. Boxes in contact with masonry or concrete shall be grey steel.
 - 4. Masonry Boxes:
 - a. Provide stamp metal masonry boxes.

- b. Use boxes with 1-gang capacity in excess of the number of devices to be installed.
- c. Extension ring covers shall not be acceptable.
- 5. Listing: UL 514.
- 6. Acceptable Manufacturers: Appleton, Bowers, Crouse-Hinds, Efcor, Midwest, OZ/Gedney, RACO, Steel City, T & B.
- B. Junction, Pull and Splice Boxes
 - 1. Construction: Provide boxes conforming to NEC Article 314.
 - 2. Interior Spaces: Provide surface mounted NEMA 12 aluminum boxes at least 4 inches deep, with continuous hinged cover.
 - 3. Exterior Spaces: NEMA 4X stainless steel type 316 boxes at least 4 inches deep.
 - 4. Embedded: Provide stainless steel 316 type with external recessed flanged cover when cast in concrete.
 - 5. Listing: UL 514.
 - 6. Acceptable Manufacturers: Hoffman, Keystone, OZ, Stahlin, Crouse-Hinds.
 - 7. Hazardous location: Box shall be NEMA rated for the application.
 - 8. Chemical areas: Box shall be rated NEMA 4X, PVC or fiberglass reinforced polyester. Fiberglass enclosures shall not be used in the presence of sodium hypochlorite. Non-metallic boxes shall have UV inhibitors and shall not be mounted in direct sunlight.
- C. Termination Cabinets & Boxes
 - 1. Termination cabinets shall be NEMA 4X 316 stainless steel gasketed. Cabinets shall be of sufficient size to adequately contain all terminals, wire-duct, and cables as determined by the CONTRACTOR. Cabinets shall have removable doors (lift-off) not more than 30 inches wide, and shall be equipped with a three-point locking latch handle.
 - 2. Wire terminal blocks shall be square D type M Barrier Block system.
 - a. M4/6G or B 22014 AWG 6MM (0.234 inch) wide, grey blue, single level, 600 volt, 20A.
 - b. M6/8G or B 22-8 AWG 8MM (0.315 inch) wide, grey blue, single level, 600 volt, 55A.
 - 3. The wire terminal block system shall be for DIN rail mounting, and shall include fuse/switch blocks, circuit breaker block, and isolation switches.
 - 4. Acceptable Manufacturers: Hoffman.

PART 3 EXECUTION

- 3.01 DEMOLITION/PREPARATION
 - A. Coordinate location of all boxes with all other work.
 - B. Verify location of floor boxes with Engineer before installation.
- 3.02 INSTALLATION
 - A. Outlet Boxes
 - 1. Flush Boxes:

- a. Unless otherwise indicated, mount all outlet boxes flush within 1/4-inch of the finished wall or ceiling line.
- b. Securely fasten outlet boxes in position using clips or other suitable means.
- c. Provide plaster covers for all boxes in plastered walls and ceilings.
- 2. Fixture Boxes: Where boxes for suspended lighting fixtures are attached to and supported from suspended ceilings, adequately distribute the load over the ceiling support members.
- 3. Mounting Height:
 - a. Mounting height of a wall-mounted outlet box means the height from finished floor to horizontal center line of the cover plate.
 - b. Where outlets are indicated adjacent to each other, mount these outlets in a symmetrical pattern with all tops at the same elevation.
 - c. Where outlets are indicated adjacent, but with different mounting heights, line up outlets to form a symmetrical vertical pattern on the wall.
 - d. Verify the final location of each outlet with Owner's Representative before rough-in.
 - e. Remove and relocate any outlet box placed in an unsuitable location.
- 4. Back-to-Back Boxes:
 - a. Do not connect outlet boxes back to back unless approval is obtained.
 - b. Where such a connection is necessary to complete a particular installation, fill the voids around the wire between the boxes with sound insulating material.
- 5. Box Openings: Provide only the conduit openings necessary to accommodate the conduits at the individual location.
- B. Floor Boxes
 - 1. Completely envelop floor boxes in concrete except at the top. Increase slab thickness at boxes if required for bottom covering. Adjust covers flush with finished floor.
- C. Junction and Pull Boxes
 - 1. Pull boxes and junction boxes shall be provided to facilitate the installation of cable and wires. "Condulet" type fittings shall not be used in lieu of boxes when the conduit contains wire #4 AWG or larger.
 - 2. Installation:
 - a. Install boxes as required to facilitate cable installation in raceway systems.
 - b. Generally provide boxes in conduit runs of more than 100 feet.
 - c. Locate boxes strategically and make them of such shape and size to permit easy pulling of wire or cables. Size boxes in accordance to NEC Article 314.28 requirements.
 - 3. Covers:
 - a. Provide boxes so that covers are readily accessible and easily removable after completion of the installation.
 - b. Include suitable access doors for boxes above suspended ceilings.
 - c. Select a practical size for each box and cover.

WIRING DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; and device plates and decorative box covers.
- 1.02 RELATED SECTIONS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 General Provisions and Division 16 Electrical Specification Sections, apply to this Section.
- 1.03 REFERENCE STANDARDS
 - A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 General Requirements for Wiring Devices.
 - 2. NEMA WD 6 Wiring Devices-Dimensional Requirements.
 - B. Wiring Devices shall be in compliance with the National Electrical Code and shall be constructed in compliance with the Underwriters' Laboratories and shall be Underwriters' Laboratories labeled.
- 1.04 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
 - C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.
- 1.05 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- 1.06 EXTRA MATERIALS
 - A. Furnish two of each style, size, and finish wall plate and device.
- PART 2 PRODUCTS
- 2.01 WALL SWITCHES
 - A. Manufacturers; Wall Switch:
 - 1. Eaton

- 2. Leviton
- 3. Lutron
- 4. Pass & Seymour
- 5. Substitutions: Division 1 General Requirements.
- B. Product Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- C. Body and Handle: Color per Architect/Engineer plastic with toggle handle.
- D. Indicator Light: When indicated on drawings, provide Lighted handle type switch with color as indicated.
- E. Ratings:
 - 1. Voltage:120-277 volts, AC.
 - 2. Current: 20 amperes.
- F. WALL DIMMERS
- G. Manufacturers:
 - 1. Leviton
 - 2. Lutron
 - 3. Pass & Seymour
 - 4. Substitutions: Section 01600 Material and Equipment.
- H. Product Description: NEMA WD 1, Type II semiconductor dimmer for incandescent lamps.
- I. Body and Handle: Color per Architect/Engineer plastic with linear slide.
- J. Voltage: 120 volts.
- K. Power Rating: Match load shown on drawings

2.02 RECEPTACLES

- A. Manufacturers:
 - 1. Eaton
 - 2. Hubbell
 - 3. Leviton
 - 4. Substitutions: Division 1 General Provisions.
- B. Product Description: NEMA WD 1, Heavy-duty general use receptacle.
- C. Device Body: Color per Architect/Engineer.
- D. Configuration: NEMA WD 6, type as indicated on Drawings.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.03 WALL PLATES

- A. Manufacturers:
 - 1. Appleton
 - 2. Levition
 - 3. Lutron
 - 4. Hubbell
 - 5. Schneider Electric
 - 6. Substitutions: Division 1 General Provisions.
- B. Decorative Cover Plate: Color per Architect/Engineer smooth nylon
- C. Industrial Cover Plates (Electrical Rooms, Process Area, all non-conditioned spaces): stainless steel.
- D. Jumbo Cover Plate: Color by Architect/Engineer smooth nylon.
- E. Weatherproof Cover Plate: Gasketed cast metal and gasketed device cover.

PART 3 EXECUTION

- 3.01 EXAMINATION
 - A. Division 1 General Provisions: Coordination and project conditions.
 - B. Verify outlet boxes are installed at proper height.
 - C. Verify wall openings are neatly cut and completely covered by wall plates.
 - D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- 3.02 PREPARATION
 - A. Clean debris from outlet boxes.
- 3.03 EXISTING WORK
 - A. Disconnect and remove abandoned wiring devices.
 - B. Modify installation to maintain access to existing wiring devices to remain active.
 - C. Clean and repair existing wiring devices to remain or to be reinstalled.
- 3.04 INSTALLATION
 - A. Install devices plumb and level.
 - B. Install switches with OFF position down.
 - C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

- D. Do not share neutral conductor on load side of dimmers.
- E. Install receptacles with grounding pole on bottom.
- F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- G. Install wall plates on flush mounted switches, receptacles, and blank outlets.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- I. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- J. Use jumbo size plates for outlets installed in masonry walls.
- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- L. Boxes:
 - 1. Finished areas such as offices: Recessed mounted devices in stamped steel boxes.
 - 2. Other areas: Surface mounted cast aluminum metal boxes.
- 3.05 INTERFACE WITH OTHER PRODUCTS
 - A. Install wall switch 48 inches (1.2 m) above finished floor.
 - B. Install convenience receptacle 18 inches (450 mm) above finished floor.
 - C. Install convenience receptacle 6 inches (150 mm) above back splash of counter.
 - D. Install dimmer 48 inches (1.2 m) above finished floor.
- 3.06 FIELD QUALITY CONTROL
 - A. Inspect each wiring device for defects.
 - B. Operate each wall switch with circuit energized and verify proper operation.
 - C. Verify each receptacle device is energized.
 - D. Test each receptacle device for proper polarity.
 - E. Test each GFCI receptacle device for proper operation.
- 3.07 ADJUSTING
 - A. Adjust devices and wall plates to be flush and level.

3.08 FIELD TESTING

- A. All GFCI outlets shall be tested per industry standard practices and manufacturer's recommendations.
- 3.09 CLEANING
 - A. Clean exposed surfaces to remove splatters and restore finish.

ENCLOSED COMBINATION SOFT START CONTROLLERS

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. These specification requirements are for solid state reduced voltage motor controllers herein referred to as soft starters.
 - B. They are for use with NEMA design B, AC motors to reduce the current in-rush as well as mechanical shocks that can result from starting or stopping a motor across the line.
- 1.02 RELATED WORK
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Division 1 General
 - 2. Division 16 Electrical.
- 1.03 SUBMITTALS (NOT USED)
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
 - C. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
 - D. Test Reports: Indicate field test and inspection procedures and test results.
 - E. Manufacturer's Field Reports: Indicate start-up inspection findings.
 - F. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.
- 1.04 REFERENCE STANDARDS
 - A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - B. National Electrical Manufacturers Association:

- 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- 2. NEMA FU 1 Low Voltage Cartridge Fuses.
- 3. NEMA ICS 7 Industrial Control and Systems
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- 1.05 QUALITY ASSURANCE
 - A. The electronic "soft starter" shall be listed by an independent testing laboratory in accordance with UL 508 Industrial Control Equipment.
 - B. The soft start shall carry the CE mark for indication of compliance to low voltage and EMC directives in accordance with EN / IEC 60947-4-2.
 - C. The manufacturer shall be a certified ISO 9002 facility.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
 - A. Section 16000 Basic Electrical Requirements.
 - B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
 - C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY
 - A. Furnish a minimum of a five-year manufacturer warranty
- PART 2 PRODUCT
- 2.01 REDUCED VOLTAGE SOFT START CONTROLLER
 - A. Manufacturers:
 - 1. Allen-Bradley
 - 2. General Electric
 - 3. Square D
- 2.02 GENERAL DESCRIPTION
 - A. The soft starter shall be provided by the manufacturer factory mounted in an enclosure rated as follows:
 - 1. NEMA Type 1 for indoor use.

- a. Enclosure shall include a door mounted digital keypad for adjusting the soft starter parameters and viewing process values and viewing the motor and soft starter status without opening the enclosure door.
- b. Provisions shall be available for padlocking the enclosure door.
- 2. NEMA 4X, SS for outdoor use
 - a. Enclosure shall include a door mounted digital keypad for adjusting the soft starter parameters and viewing process values and viewing the motor and soft starter status without opening the enclosure door. (provide a sun/weather protective cover for NEMA 4X conditions.)
 - b. Provisions shall be available for padlocking the enclosure door.
- B. The enclosed product shall be provided complete with one of the following overcurrent protective devices (OCPDs) for Type 1 short circuit protection:
 - 1. Circuit breaker disconnect means. Short circuit withstand rating shall be 65K.
- C. The motor must be automatically protected from solid state component failure by one of the following means:
 - 1. Isolation contactor that opens when the motor is stopped or when the controller detects a fault condition including a shorted SCR.
- D. The soft starter shall utilize an SCR bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors.
- E. The soft start shall provide torque control for linear acceleration independent of motor load or application type without external feedback. The gating of the SCRs will be controlled in such a manner to ensure stable and linear acceleration ramp.
- F. The soft starter shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCRs. Analog control algorithms shall not be allowed.
- G. All soft starter power ratings will utilize the same control board/module.
- H. A shorting contactor shall be standard on soft starters in all enclosure configurations. Protective features and deceleration control options integral to the soft starter shall be available even when the shorting contactor is engaged.

2.03 MOTOR DATA

- A. The soft starter shall be designed to operate a NEMA design B motor size as shown on the one line diagram.
- 2.04 RATINGS
 - A. The soft start shall be designed to operate in an ambient temperature 0°C to 40°C (14°F to 104°F). For ambient temperatures between 40°C and 60°C (104°F and 140°F), derate the current by 2% per °C above 40°C (104°F).
 - B. Storage temperature range shall be -25°C to 70°C (-13°F to 158°F).

- C. Maximum relative humidity shall be 95%, non-condensing or dripping water, conforming to IEC 60947-4-2.
- D. The soft starter shall be designed to operate in altitudes up to 1000m (3300 ft). For higher altitudes, derate by 2.2% for each additional 100 m (330 ft) with a maximum of 2000m (6600 ft).
- E. The soft starter shall be capable of operation between + / 10% of nominal voltage rating.
- F. The soft start shall automatically adapt for operation at 50 or 60 Hz, with a frequency tolerance of +/- 5%. By configuration, it will have to be capable of operation at a supply line frequency that can vary by +/- 20% during steady state operation.
- G. The soft start shall be capable of supplying 400% of rated full load current for 23 seconds at maximum ambient temperature. The soft starter shall also be capable of 10 evenly spaced starts per hour at 400% of full rated current for 12 seconds per start.
- H. The SCRs shall have a minimum P.I.V. rating of 1800 Vac. Lower rated SCRs with MOV protection are not acceptable.
- I. A seismic qualification label shall be provided for all floor mount configuration units to comply with the latest IBC 2000 and NFPA 5000 guidelines.

2.05 ADJUSTMENTS AND CONFIGURATIONS

- A. All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments is prohibited.
- B. Digital indication shall provide, as a minimum, the following conditions:
 - 1. Soft starter status ready, starting/stopping, run.
 - 2. Motor status current, torque, thermal state, power factor, operating time, power in kW.
 - 3. Fault status Motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor underload, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor overcurrent fault.
- C. The soft starter must be preset to the following for adjustment-free operation in most applications:
 - 1. Linear (torque-controlled) acceleration ramp of 15 seconds.
 - 2. Current limitation to 400% of the motor full load current rating.
 - 3. Class 10 overload protection.
 - 4. Motor current preset per NEC / NFPA 70 table 430.150 for standard hp motors.
- D. A digital keypad shall be utilized configure the following operating parameters as required:
 - 1. Motor full load amps adjustable from 40 to 130% of the soft starter's rating.
 - 2. Current limitation on starting adjustable from 150 to 700% of the motor current rating, not to exceed 500% of the soft starter rating.

- 3. Linear (torque-controlled) acceleration ramp adjustable from 1 to 60 seconds.
- 4. Initial torque adjustable from 10 to 100% of nominal motor torque.
- 5. Torque limit adjustable from 10 to 200% of nominal motor torque.
- 6. Maximum start time adjustable from 10 to 999 seconds.
- 7. Voltage boost adjustable from 50 to 100% of the nominal supply voltage.
- 8. Selection of freewheel, soft stop or braking.
- 9. Linear (torque-controlled) deceleration ramp time adjustable from 1 to 60 seconds.
- 10. Threshold to change to freewheel from a controlled deceleration ramp to freewheel stop: adjustable from 0 to 100% of the nominal motor torque.
- 11. Braking torque level adjustable from 0 to 100% effectiveness.
- 12. Selection of Class 2, 10, 10A, 15, 20, 25 or 30 motor thermal overload protection.
- E. A digital keypad shall be utilized configure the following controller parameters as required:
 - 1. Selectable automatic reset operation.
 - 2. Cancellation of the torque control loop for multi-motor installations.
 - 3. Adjustment of the stator loss estimation for specialty motors.
 - 4. Assignment of soft starter inputs and output control terminals.
 - 5. Activation of line phase reversal protection.
 - 6. Reset of motor thermal state.
 - 7. Return to factory settings.
 - 8. Activation of test mode for use with low power motors.
 - 9. Indication of elapsed time in hours of starting, running and stopping.
- F. Output relays shall provide the following status indications:
 - 1. One Form A (N.O.) minimum for indication of fault.
 - 2. One Form A (N.O.) for indication that acceleration ramp is complete and current is below 130% motor FLA (end of start).
 - 3. One Form A (N.O.) assignable to one of the following functions: motor thermal alarm, motor current level alarm, and motor underload alarm.
- G. Additional inputs and outputs shall be available to provide the following status indications:
 - 1. Two assignable control inputs for the following functions: force to freewheel stop, external fault input, disable serial link control, external motor overload reset or general fault reset.
 - 2. Two assignable logic-level signal outputs for the following functions: motor thermal overload alarm, "motor powered" signal, motor overcurrent alarm, or motor underload alarm.
 - 3. One analog output shall be available for 4 to 20 or 4 to 20 milliamp indication of motor current, motor torque, motor power, motor thermal state, or power factor.
- H. Relay and I/O functions listed above must be isolated with respect to common.

2.06 PROTECTION

A. A microprocessor-based thermal protection system shall be included which continuously calculates the temperature-rise of the motor and soft starter and provides:
- 1. A motor overload pre-alarm that indicates by relay contact or logic output that the motor windings have exceeded 130% of its rated temperature rise. This function shall be for alarm only.
- 2. A motor overload fault will stop the motor if the windings have exceeded 140% of temperature-rise.
- 3. An electronic circuit with a time-constant adjustable to the motor's thermal cooling time-constant ensuring the memorization of the thermal state even if power is removed from the soft starter.
- B. The soft starter shall provide line and motor phase loss, phase reversal, underload, stall, and jam protection.
- C. The integral protective features shall be active even when the shorting contactor is used to bypass the SCRs during steady state operation.
- 2.07 CONTROL OPTIONS
 - A. The soft starter control circuit shall be fed from the line supply and be completely independent of the power circuit and separate from the control logic.
 - B. The peripheral soft starter control circuitry shall be operated at 120 Vac 60 Hz from a control power transformer included within the enclosure.
 - C. Operator devices shall be door mounted and shall be:
 - 1. Three position H-O-A switch which provides for manual (HAND) start or remote signal (AUTO) start from user-supplied relay contacts.
 - 2. Red RUN pilot light illuminated whenever the soft starter is provided a run command and no fault condition is present.
 - 3. Green OFF pilot light illuminated whenever the soft starter is supplied with control power and no run command is present
 - 4. All operator devices shall be remote-mounted using supplied 120 Vac control logic. Clearly labeled terminals shall be provided for field installation.

2.08 COMMUNICATIONS

- A. The soft starter will have to include a multidrop serial link for its direct connection to Modbus.
- B. The soft starter shall be able to be connected to Ethernet and other networks, with connection to communication bus as an option.
- C. The communication shall be able to provide access to the control, to the adjustment and to the supervision of the soft starter.
- 2.09 SHORTING CONTACTOR (STANDARD ON ALL ENCLOSURES)
 - A. A microprocessor shall control the operation of the shorting contactor via an output relay.

- B. The shorting contactor shall close, shorting the SCRs after the acceleration ramp is compete and motor current is below 130% of motor FLA, and open on a stop command to allow a deceleration ramp.
- C. Overload protection integral to the soft starter shall continue to protect the motor when shorting is engaged.
- 2.10 FULL VOLTAGE BYPASS STARTER (WHEN SHOWN ON THE ONE LINE DIAGRAM)
 - A. A full voltage bypass starter with overload protection shall be included to provide motor operation in the case of soft starter failure.
 - B. A "NORM/BYPASS" selector switch shall be mounted on the enclosure door.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. The soft start shall be installed per the manufacturer's specifications.
 - B. A standard wiring diagram shall be included for making the appropriate electrical connections.
- 3.02 FIELD QUALITY CONTROL
 - A. Inspect and test in accordance with NETA ATS
 - B. Perform inspections and tests listed in NETA ATS and NEMA ICS
- 3.03 MANUFACTURER'S FIELD SERVICES
 - A. Manufacturer to provide 2 hours of startup and configuration services per Soft Start.
 - B. Prepare and startup starter.
- 3.04 DEMONSTRATION AND TRAINING
 - A. Furnish 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish labor, materials, equipment and incidentals necessary to install disconnects. Electrical work shall be in accordance with Division 16 Electrical.
- B. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.02 RELATED WORK

- A. Division 16 Electrical
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 General Provisions and Division 16 Electrical Specification Sections, apply to this Section.
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
 - C. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
 - D. Manufacturer's field service report.

- E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.04 QUALITY ASSURANCE

- A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.
- 1.05 DEFINITIONS
 - A. NC: Normally closed.
 - B. NO: Normally open.
 - C. SPDT: Single pole, double throw.
- 1.06 PROJECT CONDITIONS
 - A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).
 - B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Engineer no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Engineer's written permission.
 - 4. Comply with NFPA 70E.

1.07 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.08 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 PRODUCTS

- 2.01 FUSIBLE SWITCHES
 - A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. General Electric
 - 2. Square D
 - B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
 - C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
 - D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
 - E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit:Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - a. Hookstick Handle: Allows use of a hookstick to operate the handle.

- b. Lugs: Mechanical type, suitable for number, size, and conductor material.
- c. Service-Rated Switches: Labeled for use as service equipment.

2.02 NONFUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. General Electric
 - 2. Square D
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit:Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 RECEPTACLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Hubble.
- B. Type 4, IP66 Rated, Twist lock, amp rated, combination safety switch and receptacle
- C. Receptacle: Twist lock, three-phase, four-wire or five-wire receptacle (one wire connected to enclosure ground lug).

2.04 MOLDED-CASE CIRCUIT BREAKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. General Electric
 - 2. Square D
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with frontmounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiterstyle fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self- powered type with mechanical ground-fault indicator; relay with adjustable pickup and timedelay settings, push-to-test feature, internal memory, and shunt trip unit; and threephase, zero-sequence current transformer/sensor. (Provide only when shown on the single line, or required by code)
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact. (Provide when indicated on drawing)
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay. (Provide when indicated on drawings)

- 7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts. (Provide when indicated on drawing)
- 8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped. (Provide when indicated on drawing)
- 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position. (Provide when indicated on drawing)

2.05 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 4X stainless steel.
 - 3. Corrosion Areas: NEMA 250, Type 4X fiberglass.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X stainless steel.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 4X stainless steel
- PART 3 EXECUTION
- 3.01 EXAMINATION
 - A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION
 - A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
 - C. Install fuses in fusible devices.
 - D. Comply with NECA 1.
- 3.03 IDENTIFICATION
 - A. Comply with requirements in Division 16
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

- A. Inspect and test according to NETA ATS
- B. Perform circuit breaker inspections and tests listed in NETA ATS.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 16, Section 16055 – Power System Studies.

END OF SECTION

SECTION 16461

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. Section Includes:
 - 1. Two-winding transformers.
 - 2. Buck-and-boost transformers.

1.02 RELATED WORK

- A. Division 3 Concrete
- B. Division 16 Electrical

1.03 SUBMITTALS

- A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test and Evaluation Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
- D. Source Quality Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.
- F. Record Documentation: Record actual locations of transformers.
- 1.04 REFERENCE STANDARDS
 - A. National Electrical Manufacturers Association:
 - 1. NEMA ST 1 Specialty Transformers (Except General Purpose Type).
 - 2. NEMA ST 20 Dry Type Transformers for General Applications.
 - B. United States Department of Energy
 - 1. CFR Title 10 Chapter II, Part 431
 - C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Manufacturer: Transformers to be by the same manufacture as the switchboards and panelboards used on the project.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
 - B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.
 - C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
 - D. Section 16000 Basic Electrical Requirements
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 COORDINATION
 - A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
 - B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided. Transformers not specifically designed for wall mounting by the Manufacturer shall be provided with structural mounting details signed and sealed by a Registered Professional Engineer licensed in the state of the project location.
- PART 2 PRODUCTS
- 2.01 TWO-WINDING TRANSFORMERS
 - A. Manufacturers:
 - 1. General Electric
 - 2. Square D
 - 3. Division 1 Substitutions

- B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings.
- C. Operation:
 - 1. Insulation system and average winding temperature rise for rated kVA as follows:
 - 2. 1-15 kVA: Class 185 with 115 degrees C rise.
 - 3. 16-500 kVA: Class 220 with 150 degrees C rise.
 - 4. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
 - 5. Winding Taps:
 - a. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - b. Transformers 15 kVA and Larger: NEMA ST 20.
 - 6. Sound Levels: Minimum of 3 dBA less than NEMA ST 20.
 - 7. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
 - 8. Mounting:
 - a. 1-15 kVA: Suitable for wall mounting.
 - b. 16-75 kVA: Suitable for floor, or trapeze mounting.
 - c. Larger than 75 kVA: Suitable for floor mounting.
- D. Materials:
 - 1. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
 - 2. Coil Conductors: Continuous copper windings with terminations brazed or welded.
 - 3. Enclosure:
 - a. Air-Conditioned Areas: NEMA ST 20, Type 1 ventilated. Furnish lifting eyes or brackets.
 - b. Exterior/Interior Corrosive Areas: NEMA ST 20, Type 4X non-ventilated Stainless Steel. Furnish lifting eyes or brackets.
- E. Fabrication:
 - 1. Isolate core and coil from enclosure using vibration-absorbing mounts.
 - 2. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.02 BUCK-AND-BOOST TRANSFORMERS

- A. Manufacturers:
 - 1. General Electric
 - 2. Square D
 - 3. Division 1 Substitutions.
- B. Description: NEMA ST 1, factory-assembled, dry type two winding buck and boost transformers, ratings as indicated on Drawings.
- C. Operation:

- 1. Insulation system and average winding temperature rise for rated kVA as follows:
 - a. 0.25-2 kVA: Class 185 with 80 degrees C rise.
 - b. 3-7.5 kVA: Class 220 with 80 degrees C rise.
- 2. Primary Voltage: 208 volts, single phase.
- 3. Secondary Voltage: 240 volts.
- D. Materials:
 - 1. Coil Conductors: copper Continuous windings.
 - 2. Lugs: Suitable for terminating conductors sized for full load ampacity of transformer unit when operating in buck-and-boost configuration shown.
 - 3. Enclosure: NEMA ST 1, Type 1.
- E. Fabrication:
 - 1. Isolate core and coil from enclosure using vibration-absorbing mounts.
 - 2. Nameplate: Include transformer connection data.
- 2.03 SOURCE QUALITY CONTROL
 - A. Section 01360 Quality Control: Testing, inspection and analysis requirements.
 - B. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 16 Section Grounding have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected
- F. Verify mounting supports are properly sized and located including concealed bracing in walls.
- 3.02 PREPARATION
 - A. Provide concrete pads under provisions of Division 3.
- 3.03 DEMOLITION
 - A. Disconnect and remove abandoned transformers.

- B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.
- 3.04 INSTALLATION
 - A. Set transformer plumb and level.
 - B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
 - C. Support transformers as required.
 - 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
 - 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
 - 3. Mount trapeze-mounted transformers as indicated on Drawings.
 - D. Provide seismic restraints.
 - E. Install grounding and bonding in accordance with Division 16 and as shown on the plans.

3.05 REPAIR

- A. Repair existing transformers to remain or to be reinstalled.
- 3.06 FIELD QUALITY CONTROL
 - A. Inspect and test in accordance with NETA ATS.
 - B. Perform inspections and tests listed in NETA ATS.
- 3.07 ADJUSTING
 - A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
 - B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
 - C. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals

3.08 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning
- B. Clean existing transformers to remain or to be reinstalled.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. Furnish and install distribution and branch circuit panelboards.
- 1.02 RELATED WORK
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Division 1 General
 - 2. Division 16 Electrical.
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Product Data: Submit catalog data showing specified features of standard products.
 - C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.
 - 1. Breaker layout drawing with dimensions indicated and nameplate designation.
 - 2. Component list.
 - 3. Conduit entry/exit locations.
 - 4. Assembly ratings including:
 - a. Short-circuit rating.
 - b. Voltage.
 - c. Continuous current.
 - 5. Breaker cable terminal sizes
 - D. Submit a letter indicating that the panelboard breakers being supplied have been coordinated with the General Contractor relating to the HVAC equipment being supplied. The letter shall indicate that all required breaks need to power the HVAC equipment are included.
 - E. Submit a letter indicating that the panelboard breakers being supplied have been coordinated with the General Contractor relating to the Process Equipment being supplied. The letter shall indicate that all required breaks need to power the Process Equipment are included.

- F. No Panelboards will be approved until the Power System Study has been approved. Breaker Back Boxes can be approved on a provisional basis to allow for electrical rough in.
- G. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.
- H. Section 01700 Closeout Contract: Requirements for submittals.
- I. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- J. Operation and Maintenance Data: Submit spare parts listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- K. Section 01700 Closeout Contract: Requirements for maintenance products.
- L. Extra Stock Materials:
 - 1. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

1.04 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers.
 - 2. NEMA AB 2 Procedures for Verifying the Performance of Molded Case Circuit Breakers.
 - 3. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 4. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 5. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 6. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 7. NEMA PB 1 Panelboards.
 - 8. NEMA PB 1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- E. UL:

- 1. UL 50 Cabinets and Boxes
- 2. UL 67 Safety for Panelboards.
- 3. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
- 4. UL 1283 Electromagnetic Interference Filters.
- 5. UL 1449 Transient Voltage Surge Suppressors.
- 6. UL 1699 Arc-Fault Circuit Interrupters.

1.05 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
 - 2. Equipment submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE
 - A. Store in accordance with Section 16000 Basic Electrical Requirements
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY
 - A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for a minimum of 2 years beginning after completion of the initial operation period.
- PART 2 PRODUCTS
- 2.01 PANELBOARDS
 - A. Manufacturers:
 - 1. General Electric
 - 2. Square D
 - 3. Substitutions: Section 01600 Material and Equipment.
 - B. Description: NEMA PB 1, circuit breaker type panelboard.
 - C. Circuit Identification
 - 1. Directory:
 - a. For each panelboard, provide a directory frame mounted inside the door with a heat-resistant transparent face and a directory card for identifying the load served.
 - b. Type directory as specified in Division 16 Electrical.
 - 2. Nameplate:

a. Provide a black on white phenolic nameplate on the face of the panelboard using the following as an example:

Panel HA

277/480V, 30, 4W

Feeder from MCC-B/Section

- b. The nameplate shall have a minimum thickness of 1/8" and be mounted above the panel door.
- D. Listing
 - 1. UL 67 Electric Panelboards.
- E. Special Requirements
 - 1. All copper items, including wiring, terminal blocks, lugs, connectors, bus, etc., shall be tin plated copper.
 - 2. All steel shall be primed and painted as specified. Galvanized items shall also be painted.
 - 3. All hardware, including nuts, bolts, washers, screws, anchor bolts, door hinges, etc., shall be made of 316 stainless steel.
 - 4. The panelboard steel parts shall be cleaned and sprayed in control cleaning solutions by a multi-stage spray washer. The operation shall produce a coating of a minimum of 150 milligrams per square foot to meet MIL Specification TT-C490. The primed metal parts shall be electrostatically coated with power paint to a thickness of 2.5mils. The paint finish shall withstand a minimum of 1000hours salt spray test.
- F. Bus
 - 1. Material
 - a. Provide tin-plated, copper bus bars, 98 percent IACS conductivity, full-sized throughout their length.
 - b. Use buses with tin-plated contact surfaces.
 - c. Include a tin-plated copper bus bar ground bus in panelboard rated.
 - d. Full size (100% rated) insulated neutral bus shall be included in the panel board, shown with neutral. 200% rated neutral bus shall be supplied for panels designated on the drawings.
 - e. The ground and neutral bus shall be at least one terminal screw for each circuit.
 - f. Provide through feed or sub feed lugs where indicated.
 - g. Provide lugs and connection points on phase, neutral and ground bus suitable for copper conductors.
 - h. Spaces for future circuit breakers shall be bussed for the maximum devices that can be fitted.
 - 2. Size bars as indicated and brace them to withstand the available symmetrical short circuit current.
 - 3. Installation:
 - a. Install buses in allotted spaces so that devices can be added without additional machining, drilling or tapping.
 - b. Mount neutral bars, as required, on the opposite end of the main lugs.
- G. Protective Devices

- 1. Circuit Breakers: Provide circuit breakers for the specified service with the number of poles and ampere ratings indicated.
 - a. Provide breakers which are quick-make and quick-break on both manual and automatic operation.
 - b. Use a trip-free trip indicating breaker.
 - c. Incorporate inverse time characteristic by bimetallic overload elements and instantaneous characteristic by magnetic trip. Where indicated, provide ground fault circuit breakers (GFCB).
 - d. For 2-pole and 3-pole breakers, use the common-trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable.
 - e. Unless otherwise indicated, provide circuit breakers with the following interrupting ratings:
 - (i) Each circuit breaker used in 120/208 Volt panelboards shall have an interrupting capacity of not less than 22,000 Amps, RMS symmetrical.
 - (ii) Each circuit breaker used in 277/480 Volt and 480 Volt panelboards shall have an interrupting capacity of not less than 42,000 Amps, RMS symmetrical.
 - (iii) GFCI (ground fault circuit interrupter) shall be provided for circuits where shown on the drawings. GFCI units shall be 1 Pole, 120 Volt, molded case, bolt-on breakers, incorporating a solid-state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 22,000 Amps, RMS.
 - (iv) Circuit breakers shall be as manufactured by the panelboard manufacturer.
 - f. Connect breakers to the main bus by means of a solidly bolted connection.
 - g. Use breakers which are interchangeable, capable of being operated in any position within the panel.
 - h. Each panelboard shall be equipped with a minimum of 20 percent spare breakers, with spaces, bus work, and terminators to complete the next standard size panelboards above the 20% requirement.
 - i. Independently mount breakers so that a single unit can be removed from the front of the panel without disturbing or removing the main bus, other units or other branch circuit connections.
 - j. Provide individual breaker handle lock for all circuits that supply exit signs, emergency lights, and fire alarm panels.
 - k. Provide GFI circuit breakers for heat trace circuit. The rating shall be as per NEC.
- H. Surge Suppressor
 - 1. Integral Surge Suppressers:
 - a. Maximum single impulse current rating not less than 80 kA for each phase.
 - b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
 - c. Clamping Voltage:
 - (i) 208Y/120 Configuration:
 - (a) L-N: 500 V.

- (b) N-G: 500 V.
- (c) L-G: 500 V.
- (ii) 480Y/277 Configuration:
 - (a) L-N: 1,000 V.
 - (b) N-G: 1,000 V.
 - (c) L-G: 1,000 V.
- d. Integral Surge Suppresser Fabrication:
 - (i) Manufactured by the Panelboard Manufacturer
 - (ii) Furnish copper bus bars for surge current path.
 - (iii) Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
 - (iv) Furnish response time no greater than five nanoseconds for individual protection modes.
 - (v) Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
 - (vi) Furnish visible indication of proper suppresser connection and operation. Lights indicate operable phase and module.
 - (vii) Furnish minimum EFI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50:1 using Mil Std. 220A methodology.
- e. Provide a UL label for all panelboard mounted surge suppressors
- 2. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
- 3. Enclosure:
 - a. Indoor Air-Conditioned Spaces:
 - (i) NEMA Type 1
 - (ii) Cabinet Front: Surface door-in-door type, fastened with hinged door with flush lock and metal directory frame.
 - b. Corrosive Spaces:
 - (i) NEMA 4X Fiberglass
 - c. Exterior Locations:
 - (i) NEMA 4X Stainless Steel
 - d. nominal current rating as indicated on Drawings.

2.02 SOURCE QUALITY CONTROL

- A. Division 16 Electrical
- B. Independently test integral surge suppressers with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.
- PART 3 EXECUTION
- 3.01 DEMOLITION
 - A. Disconnect abandoned panelboards. Remove abandoned panelboards.

- B. Maintain access to existing panelboard remaining active and requiring access. Modify installation or provide access panel.
- 3.02 INSTALLATION
 - A. Install panelboards according to NEMA PB 1.1.
 - B. Install panelboards plumb.
 - C. Install recessed panelboards flush with wall finishes.
 - D. Height: 6 feet (1 800 mm) to top of panelboard; install panelboards taller than 6 feet (1 800 mm) with bottom no more than 4 inches (100 mm) above floor.
 - E. Install filler plates for unused spaces in panelboards.
 - F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.
 - G. Install engraved plastic nameplates according to Division 16.
 - H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: five empty 1 inch (DN27). Identify each as spare.
 - I. Ground and bond panelboard enclosure according to Division 16. Connect equipment ground bars of panels according to NFPA 70.
 - J. In wet and corrosive areas, including outdoor locations, install stainless steel 316 panelboard enclosures on Type 316 stainless steel unistrut support to provide clearance behind the mounting surface.
- 3.03 RESTORATION
 - A. Repair existing panelboards to remain or to be reinstalled.
- 3.04 FIELD QUALITY CONTROL
 - A. Inspect and test according to NETA ATS
 - B. Perform circuit breaker inspections and tests listed in NETA ATS.
- 3.05 ADJUSTING
 - A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- 3.06 FIELD PAINTNG
 - A. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.07 CLEANING

A. Remove debris from installation site and wipe dust and dirt from all components

END OF SECTION

SECTION 16491

FUSES

1.01 SCOPE OF WORK

A. Section Includes:

- 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor-control centers.
- 2. Spare-fuse cabinets.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 4. Coordination charts and tables and related data.
 - D. Section 01700 Contract Closeout: Closeout procedures.
 - E. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.04 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association:1. NEMA FU 1 Low Voltage Cartridge Fuses.
- 1.05 QUALITY ASSURANCE
 - A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
 - B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - D. Comply with NEMA FU 1 for cartridge fuses.
 - E. Comply with NFPA 70.
 - F. Comply with UL 248-11 for plug fuses.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS
 - A. Spare Parts:
 - 1. Furnish two fuse pullers.
 - B. Extra Materials:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.02 DESIGN REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.
- B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

- A. Cartridge Fuses (provide fuse type indicated below unless otherwise shown on Drawings or required by breaker coordination study):
 - 1. Service Entrance: Class T, fast acting.
 - 2. Feeders: Class RK1, time delay.
 - 3. Motor Branch Circuits: Class RK5, time delay.
 - 4. Other Branch Circuits: Class RK5, time delay.
 - 5. Control Circuits: Class CC, fast acting.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).
- 3.04 IDENTIFICATION
 - A. Install labels complying with requirements for identification specified in Division 16 Section "Electrical Identification" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

3.05 DOMOLITION

- A. Remove fuses from abandoned circuits.
- B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.

END OF SECTION

SECTION 16520

EXTERIOR LIGHTING

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. Section includes exterior luminaries, poles, and accessories.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
 - C. Product Data: Submit dimensions, ratings, and performance data.
 - D. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.
- 1.04 REFERENCE STANDARDS
 - A. American National Standards Institute:
 - 1. ANSI C82.1 American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 3. ANSI O5.1 Wood Poles, Specifications and Dimensions.
- 1.05 QUALITY ASSURANCE
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Division 1-Product storage and handling requirements.
 - B. Store and handle solid wood poles in accordance with ANSI O5.1.
- 1.08 MAINTENANCE/SPARE PARTS
 - A. Section 01700 Contract Closeout: Spare parts and maintenance products.
 - B. Furnish two of each lamp or LED drive installed.

- C. Furnish two quarts gallons of touch-up paint for each different painted finish and color.
- D. Furnish two ballasts of each lamp type installed.
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 COORDINATION
 - A. Division 1 Coordination and project conditions.
 - B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.
- PART 2 PRODUCTS
- 2.01 LUMINAIRES AND POLES
 - A. Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.
- PART 3 EXECUTION
- 3.01 EXAMINATION
 - A. Verify foundations are ready to receive fixtures.
- 3.02 EXISTING WORK
 - A. Disconnect and remove abandoned exterior luminaries.
 - B. Extend existing exterior luminaire installations using materials and methods compatible with existing installations, or as specified.
 - C. Clean and repair existing exterior luminaries to remain or to be reinstalled.
- 3.03 INSTALLATION
 - A. Install concrete bases for lighting poles at locations as indicated on Drawings, in accordance with Division 3.
 - B. Install poles plumb. Install double nuts to adjust plumb. Grout around each base.
 - C. Install lamps in each luminaire.
 - D. Bond and ground luminaries, metal accessories and metal poles in accordance with Division 16. Install supplementary grounding electrode at each pole.
 - E. Install fuse holders and surge protection devices at each pole
- 3.04 FIELD QUALITY CONTROL
 - A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
 - B. Measure illumination levels to verify conformance with performance requirements.

- C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.
- 3.05 ADJUSTING
 - A. Aim and adjust luminaries to provide illumination levels and distribution as recommended by IES guidelines.
- 3.06 CLEANING
 - A. Division 1 Final cleaning.
 - B. Clean photometric control surfaces as recommended by manufacturer.
 - C. Clean finishes and touch up damage.
- 3.07 PROTECTION OF FINISHED WORK
 - A. Division 1 Protecting finished work.
 - B. Relamp luminaries having failed lamps at Substantial Completion.
- 3.08 SCHEDULES
 - A. See Drawings for fixture and pole callouts

END OF SECTION

SECTION 16600

UNDERGROUND SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install a complete underground system of raceways, manholes and handholes as shown on the Drawings and as specified herein.
- 1.02 RELATED WORK
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Division 1 General
 - 2. Division 16 Electrical.

1.03 SUBMITTALS

- A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
- B. Submit shop drawings and product data, for the following:
 - 1. Manholes, handholes and associated hardware.
 - 2. Underground Ducts
 - 3. Concrete Backfill
 - 4. Plastic duct spacers
- C. Submittals shall also contain information on related equipment to be furnished under this Specification. Incomplete submittals not containing the required information on the related equipment will be returned unreviewed.
- D. Provide manhole and handhole NEC sizing calculations for all manholes and handholes used on the project. Sizing calculations shall be provided with initial submittal.

1.04 REFERENCE STANDARDS

- A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 - 1. NFPA 70 National Electrical Code (NEC)
 - 2. NFPA 70E Standard For Electrical Safety in the Workplace
 - 3. ASTM A615/A615M-06a Standard Specification for Deformed and Plain Carbon-Steel Bars for concrete Reinforcement
 - 4. ASTM A48 Standard Specification for Gray Iron Castings
 - 5. ASTM A536 Standard Specification for Ductile Iron Castings
 - AASHTO M306-04/ ASTM A48 Drainage Structure Castings, Section 7.0 Proof Load Testing

- 7. ASTM C-850- Specifications for underground precast concrete utility structures
- B. All excavation, trenching, and related sheeting, bracing, etc., as shown on the Drawings and listed in these Specifications, shall comply with the following standards (unless otherwise noted):
 - 1. Occupational Safety and Health Administration (OSHA)
 - a. Excavation safety standards (29 CFR Part 1926.650 Subpart P) Excavation.
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM D 698a Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).
- C. All equipment specified in this section of the Specifications shall bear the appropriate label of Underwriters Laboratories.
- 1.05 QUALITY ASSURANCE
 - A. The manufacturer of these materials shall have produced similar electrical materials and equipment for a minimum period of five (5) years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
 - B. The precast manholes shall be manufactured in a NPCA (National Precast Concrete Association) Certified Plant.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY STORAGE AND HANDLING
 - A. Equipment shall be handled and stored in accordance with manufacturer's instructions.
 - B. Protect equipment and materials from exposure to the elements and keep thoroughly clean and dry until installation.
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY
 - A. Base Warranty per Division 1
- 1.10 COORDINATION
 - A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field
 - B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Engineer

PART 2 PRODUCTS

2.01 MATERIALS

A. Raceways

- 1. Raceways shall be rigid polyvinyl chloride conduit Schedule 40, encased in concrete, as manufactured by Carlon; An Indian Head Co.; Kraloy Products Co., Inc.; Highland Plastics Inc. Thinwall conduit designated for encased burial as (Type EB) is not acceptable for any application.
- 2. All underground raceways of the underground system, terminating in manholes or handholes shall use bell end fittings of the same size and type as the raceway. Bell ends and duct spacers shall be as manufactured by Carlon.
- 3. Concrete encasement for raceways and duct banks shall be normal weight concrete weighing not more than 145 pcf with compressive strength a minimum of 3000 psi at 28 days, as specified in Section 16033, and of dimensions as shown on the Drawings.
- 4. Reinforcing steel shall comply with ASTM A615 Grade 60 as specified in Division 16, and of a size and installation as shown on the Drawings.
- 5. Where raceways terminate into existing and new manholes, handholes or structures which have flanged threaded couplers in the wall of the manhole or structure, threaded splice bars 24 inches in length shall be installed in all of the existing threaded couplers for that bank, and the threaded splice bars lapped into the duct bank steel for the last 24 inches length of the duct bank, and tied to the duct bank reinforcing steel at the end for that length.
- 6. Where raceways terminate into existing manholes, handholes or structures which do not have flanged threaded couplers in the wall of the manhole or structure, the bank duct reinforcing steel shall be dowelled into the existing structure, manhole or handhole wall at least ½ of the wall thickness, and secured with epoxy compound. The last 10' of the duct bank reinforcing shall be one bar size larger than shown for the encasement reinforcing.
- 7. All new manholes and handholes shall be provided with threaded splice bars, setting bars, and threaded rebar couplers, as manufactured by Meadow Burke Inc., Tampa, FL. for overlapping the duct bank reinforcing steel with screwlock couplers, as shown on the Drawings.
- B. Manholes and Handholes
 - 1. General
 - a. Manholes and handholes shall be of the precast concrete type, designed for a Class H20 load with sizes as shown on the Drawings, and as manufactured by Oldcastle Precast.
 - 2. Construction
 - a. Concrete for manholes and handholes shall have a 28-day compressive strength of 5000 PSI. Cement shall be Type 1 or III. Reinforcing steel shall be Grade 60 with yield strength of 60,000 P.S. Design loadings shall be H-20-44 w/impact.
 - b. Duct bank entries into the manhole or handhole shall be centered on the entering wall.
 - c. Where present or future duct banks are shown to terminate at a manhole or handhole, the terminating area of the manhole wall within the confines of the duct bank steel reinforcing shall be recessed approximately 1-1/2" for shear support, with beveled edges, all as shown on the Drawings.

- d. Each manhole and handhole shall have a 18" x 18" x 24" deep concrete sump in one corner of the manhole or handhole.
- 3. Manhole Covers
 - a. Unless otherwise shown on the Drawings, manhole and handhole covers shall be heavy duty 36 in. machined gray iron, and AASHTO M306-04/ ASTM A48 CL35B Min., 40,000-pound proof load value (Class H20 X 2.5) "True Traffic" load covers, complete with frame, and "Electric" or "Communication" raised lettering recessed flush, as required, on the cover. Covers shall be V-1600-5, with drop handles as manufactured by East Jordan IronWorks, Ardmore, OK
 - b. All castings shall be made In the USA, cast with the foundry's name, part number, "Made in USA", and production date (example: mm/dd/yy). Castings without proper markings will be rejected. Manufacturer shall certify that all castings conform to the ASTM and AASHTO Designations as specified herein. All casting shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting strength and value for the service intended. Angles shall be filleted, and arises shall be sharp and true.
- 4. Hardware
 - a. Cable racks shall be of the heavy duty non-metallic type with arm lengths of 8", 14" and 20", each supporting a load of not less than 250 lbs. at the outer end. Racks shall be molded in one piece of U.L. listed glass reinforced nylon, Catalog CR36N with RA08N, RA14N and RA20N arms as manufactured by Underground Devices Inc. Northbrook, IL. Cable racks shall have reinforced nylon inserts cast flush in the manhole and handhole walls and the rack secured by 316 stainless steel bolts. Arms for racks shall be vertically spaced not greater than 24" on centers. Furnish inserts for all present and future cable racks as shown on the Drawings.
 - b. Pulling irons shall be of copolymer polypropylene coated ½" dia. cable, tensile strength rated at 270,000 psi, with polyethylene pulling iron pocket, all recessed in the manhole wall opposite each duct entry. Pulling irons for handholes shall have the pulling iron located in the floor of the handhole near the center of the handhole opposite the duct entry. Pulling irons shall be as manufactured by M.A. Industries, Inc. Peachtree, GA. or Bowco Industries, PortlandOR.
 - c. Each manhole shall have a $\frac{3}{4} \times 10^{\circ}$ tin-plated copper ground rod inserted through the floor of the manhole or handhole, and epoxy sealed. Provide a $\frac{#4}{0}$ bare tinned copper conductor ring around the inside perimeter of the manhole. Connect the access hatch, ladder, etc. with a #6 AWG tinned copper conductor.
 - d. Manhole and handhole ladders shall be constructed of fiberglass reinforced plastic, safety yellow, 18" rung width with 12" rung spacings, Safrail as manufactured by Strongwell Corp., Bristol, VA. Furnish a total of two ladders, each of a length 4' greater than the deepest manhole in the underground system.

2.02 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Description: Comply with SCTE 77.
 - 1. Color: Gray or Engineer approved equal.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

- 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 5. Cover Legend: Molded lettering, as indicated for each service.
- 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- 7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 8. Handholes 12 inches wide by 24 inches long and larger shall have factory- installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or Engineer approved equal:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheetmolded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or Engineer approved equal:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or Engineer approved equal:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.
- E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymerpolypropylene. Cover shall be plastic.

- 1. 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:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or Engineer approved equal:
 - a. Carson Industries LLC.
 - b. Nordic Fiberglass, Inc.
 - c. PenCell Plastics.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall field verify the routing of all underground duct banks before placement. He shall modify the routing as necessary to avoid underground utilities or above ground objects. Modification or rerouting for the convenience of the Contractor, or to reduce the length of duct run as designed, will not be permitted. The Contractor shall provide any alternate routing of the duct banks to the Owner/Engineer and, after approval, shall proceed with the installation.
- B. The Contractor shall saw cut and repair existing pavements above new and modified existing duct banks. The Contractor shall provide the alternate routing of the duct banks to the Owner/Engineer and after approval shall proceed with the installation.
- C. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3 in per 100 ft.
- D. Reinforce raceway banks as shown on the Drawings.
- E. A #4/0 stranded bare copper ground conductor shall be threaded through the lower tier of duct spacers, as shown on the Drawings, for the full length of each duct run between manholes and handholes, entering the duct bank opening at each manhole, and bonded to the ground rod in the floor of each manhole and handhole.
- F. Lay raceway lines in trenches on compacted earth as specified in Division 16.
- G. Use plastic spacers located not more than 4 ft apart to hold raceways in place. Spacers shall provide not less than 2 in clearance between raceways.
- H. The minimum cover for raceway banks shall be 24 in unless otherwise permitted by the Owner/Engineer.
- I. Raceway terminations at all manholes, existing and new, shall be with end bells for PVC conduit.
- J. Where bends in raceways greater than 15 degrees are required, use long radius elbows, sweeps and offsets of PVC coated aluminum conduit. Tape unions and transitions of PVC coated aluminum conduit such that the aluminum does not come into contact with the concrete.

- K. The ends of all ducts shall be tightly plugged to exclude dust and moisture during construction. Duxseal shall be used in all applications. Plugging with tape is prohibited, even for a temporary time.
- L. Where raceways enter or exit the Underground System, and the raceways rise to a higher elevation upon entering or leaving the System, such raceways shall be tightly sealed at the higher elevation, both before and after the installation of cables, such that there shall be no entry of water or moisture to the Underground System at any time.
- M. No wire shall be pulled until the duct system has been completed in every detail.
- N. Swab all raceways clean before installing cable.
- O. Train cables in manholes and handholes and support and restrain them on cable racks. All cables passing manhole duct entrances in the manhole or handhole shall pass above all duct entrances. No cable shall pass in front of or below duct bank entrances.

3.02 TRENCH EXCAVATION

- A. The excavation shall extend to the width and depth as shown on the Drawings, or as specified, and shall provide suitable room for installing manholes, handholes, ducts and appurtenances.
- B. Furnish and place all sheeting, bracing and supports.
- C. Excavation shall include material of every description and of whatever substance encountered, regardless of the methods or equipment required to remove the material. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.
- D. The Contractor shall strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- E. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected, as provided for in the Contract Documents.
- F. Materials shall be excavated to the depth indicated on the Drawings and in widths sufficient for installing manholes and laying the ducts. Coordinate the trench width the Details shown on the Drawings. The bottom of the excavations shall be firm and dry in all respects acceptable to the Owner/Engineer. Trench width shall be a practical minimum, but not less than 6 inches greater than the total duct section arrangement, including reinforcing steel.
- G. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below, the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods, shall be removed and replaced by gravel fill, of aggregate as specified in Division 3, as required by the Owner/Engineer at the Contractor's expense.
3.03 EXCAVATION BELOW GRADE AND REFILL

- A. Regardless of the nature of unstable material encountered, or the groundwater conditions, trench and excavation drainage shall be complete and effective.
- B. If deemed necessary by the Owner/Engineer, or as shown on the Drawings, the Contractor shall be required to deposit pea gravel for duct bedding or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatsoever. All excavation shall be made in open trenches. Gravel used for this purpose, shall be aggregate as specified in Division 16, with a maximum coarse aggregate size of ³/₄ inch.

3.04 BACKFILLING

- A. Remove from the excavation all materials which the Owner/Engineer may deem unsuitable for backfilling.
- B. Backfilling shall not commence until, not less than 48 hrs after placing of any concrete embedment, have lapsed.
- C. Where the ductbanks are laid in the yard, the remainder of the trench, after concrete encasement, shall be filled with common fill material, void of rock or other non-porous material, in layers not to exceed 8-in in loose measure and compacted to 90% standard Proctor density at optimum moisture content of +/- 4%. The backfill shall be mounded 6-in above the existing grade or as directed by the Owner/Engineer. Where a grass, loam or gravel surface exists prior to excavations in the yard, it shall be removed, conserved and replaced to the full original depth as part of the work under the duct items. In some areas it may be necessary to remove excess material during the cleanup process, so that the ground may be restored to its original level and condition.
- D. Where the ductbanks are laid in paved areas or designated future paved areas, existing or designated future structures, or other existing or future utilities, the remainder of the trench above the encasement, shall be backfilled with select common fill or select fill material in layers not to exceed 8-inches loose measure and compacted at optimum moisture content
- E. (+/- 3%) to 95 percent standard Proctor density. The top 18-inches below subgrade level shall be compacted at optimum moisture content (+/- 3%) to 100 percent of standard Proctor density.
- F. Compaction shall be by use of hand or pneumatic tamping with tools weighing at least 20 lbs. The material being spread and compacted shall be placed in layers not over 8in loose thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.
- G. Bituminous paving shall not be placed in backfill.
- H. Water jetting will not be accepted as a means of consolidating or compacting backfill.
- I. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.05 RESTORING TRENCH AND ADJACENT SURFACES

- A. In paved areas, the edge of the existing pavement to be removed shall be cut along straight lines, and the pavement replaced with the same type and quality of the existing paving.
- B. In sections where the ductbank passes through grassed areas, the Contractor shall, at his own expense, remove and replace the sod, or shall loam and reseed the surface to the satisfaction of the Owner/Engineer.

3.06 CLEANING

A. Remove all rubbish and debris from inside and around the underground system. Remove dirt, dust, or concrete spatter from the interior and exterior of manholes, handholes and structures, using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as shown on the Drawings and as specified herein.
- B. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.
- C. Section Includes:
 - 1. Rod electrodes.
 - 2. Active electrodes.
 - 3. Wire.
 - 4. Grounding well components.
 - 5. Mechanical connectors.
 - 6. Exothermic connections.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Division 1 General
 - 2. Division 16 Electrical.
- 1.03 SUBMITTALS
 - A. Submit per Division 1 General Provisions, and Section 16000 Basic Electrical Requirements
 - B. Product Data: Submit catalog data showing specified features of standard products.
 - C. Product Data: Submit data on grounding electrodes and connections.
 - D. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
 - E. Manufacturer's Installation Instructions: Submit for active electrodes.
 - F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 - G. Section 01700 Contract Closeout: Requirements for submittals.
 - H. Project Record Documents: Record actual locations of components and grounding electrodes.

- 1.04 REFERENCE STANDARDS
 - A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
 - B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 99 Standard for Health Care Facilities.
- 1.05 QUALITY ASSURANCE
 - A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
 - B. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
 - C. Installer: Company specializing in performing work of this section with minimum 5 years documented experience.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS
 - A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring as shown on the drawings.
 - 5. Rod electrode.
 - 6. Plate electrode.
 - B. Grounding System Resistance: 5 ohms maximum.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Section 16000 Basic Electrical Requirements
 - B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
 - C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
 - D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 COORDINATION
 - A. Complete grounding and bonding of building reinforcing steel prior concrete placement.
- PART 2 PRODUCTS
- 2.01 ROD ELECTRODES
 - A. Product Description:
 - 1. Material: Stainless Steel.
 - 2. Diameter: 3/4 inch (19 mm).
 - 3. Length: 10 feet (3.0 m) Sections
 - 4. Total Length: As shown on the drawings
 - B. Connector: Connector for exothermic welded connection.
- 2.02 WIRE
 - A. Material: Stranded Tinned copper.
 - B. Sizes:
 - 1. 4/0 Counterpoise
 - 2. 4/0 Switchboard Bonding Jumpers
 - 3. #2 Bonding jumpers for all other as allowed by the NEC
- 2.03 GROUNDING WELL COMPONENTS
 - A. Test Well box: 12" x 12" x 12" Open Bottom Polymer Concrete
 - B. Well Cover: Polymer Concrete with legend "GROUND" cast in cover.
- 2.04 MECHANICAL CONNECTORS
 - A. Manufacturers:
 - 1. Burndy
 - 2. Substitutions: Division 1 General Requirements.
 - B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.
- 2.05 EXOTHERMIC CONNECTIONS
 - A. Manufacturers:
 - 1. Cadweld
 - 2. Substitutions: Division 1 General Requirements

- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
- PART 3 EXECUTION
- 3.01 EXAMINATION
 - A. Verify final backfill and compaction has been completed before driving rod electrodes.
- 3.02 PREPARATION
 - A. Remove paint, rust, mill oils, surface contaminants at connection points.
- 3.03 EXISTING WORK
 - A. Modify existing grounding system to maintain continuity to accommodate renovations.
 - B. Extend existing grounding system using materials and methods compatible with existing electrical installations.
- 3.04 INSTALLATION
 - A. Install in accordance with IEEE 142.
 - B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
 - C. Install grounding and bonding conductors concealed from view.
 - D. Install grounding well pipe with cover at rod locations as indicated on Drawings. Install well boxes top flush with finished grade.
 - E. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.
 - F. Bond together metal siding not attached to grounded structure; bond to ground.
 - G. Bond together reinforcing steel and metal accessories in fountain structures.
 - H. Install isolated grounding conductor for circuits shown on the drawing in accordance with IEEE 1100.
 - 1. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
 - I. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.
 - J. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
 - K. Connect to site grounding system.

- L. Bond to lightning protection system.
- M. Install continuous grounding using underground cold-water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- N. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- O. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- P. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- Q. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- R. Permanently attach equipment and grounding conductors prior to energizing equipment.
- S. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

3.05 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or

handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits

- D. Pad-Mounted Transformers and Switches: Install four ground rods and a ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install bare copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 24 inches from the foundation. Install a ground rod at each corner of the ground ring.
- 3.06 FIELD QUALITY CONTROL
 - A. Division 1 Field inspecting, testing, adjusting, and balancing.
 - B. Inspect and test in accordance with NETA ATS
 - C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS
 - D. Perform ground resistance testing in accordance with IEEE 142.
 - E. Perform leakage current tests in accordance with NFPA 99.
 - F. Perform continuity testing in accordance with IEEE 142.
 - G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.
- 3.07 DESIRED GROUND RESISTANCE
 - A. The Contractor shall report ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Control System Integrator shall be responsible for integrating the Owner furnished and Contractor furnished equipment, material, and software into a fully operational control system.
- B. The Control System Integrator shall work directly for the General Contractor.
- C. The Control System Integrator will be responsible for supplying the following equipment and materials:
 - 1. All field instruments
 - 2. All CAT 5e patch cables
 - 3. All mechanical control panels
 - 4. All lift station SCADA Panels
 - 5. All miscellaneous items required for a fully operational control system
- D. The Owner will be responsible for supplying the following products and services:
 1. All radios.
- E. The Integrator shall review all mechanical process and electrical equipment shop drawings for contractor furnished equipment to ensure that the equipment being provided will properly interface with the control system.
- F. The Control System Integrator shall provide all software for this project to be installed by the Integrator. This software shall include but not be limited to the following: all PLC code, all HMI screens, all SCADA software, all reporting applications, all database configurations, and miscellaneous software as required to produce a fully operational system.
- G. The Integrator shall provide the following drawing for the control and electrical system (Each of these drawings shall be submitted and approved as a shop drawing.):
 - 1. PID Drawings
 - 2. Block interconnection drawings for the control system and associated electrical equipment.
 - 3. Point to Point wiring diagrams for all equipment connected to the control system.
 - 4. Control Panel Drawing for any panel being built by the Integrator
 - 5. Equipment specification sheets
 - 6. Flow charts and control narratives for all control system logic to be approved by the Owner prior to implementation
- H. The Integrator shall provide the following Operation and Maintenance Manuals for the control system (Each of these shall be custom written by the Integrator. In addition, each manual shall be submitted and approved as a shop drawing.):
 - 1. Control System Operations Manual

- 2. Control System Maintenance Manual
- 3. Laminated Trouble Shooting Guides for both the Operators and the Maintenance Staff
- I. The Contractor shall furnish and install all wiring, piping, conduits and necessary mounting and accessory equipment to provide a complete and fully operational instrumentation and control system.
- J. In addition to the requirements listed the System Integrator shall provide the services and functions as defined in the project plans and specifications including:
 - 1. Design and implement lift station SCADA system
 - 2. Develop the control algorithms and code
 - 3. Develop the HMI graphics for the SCADA system
 - 4. Develop System Reports
 - 5. Implement the design and functionally test each panel
 - 6. Provide system wide Acceptance Testing
 - 7. Communicate and coordinate with the Contractor on the project construction, installation, and testing schedules
 - 8. Provide operator and maintenance training on the operation and maintenance of the SCADA system
 - 9. Provide field start-up services during the construction period to ensure all devices are properly installed and configured
 - 10. Field test all I/O points and control algorithms for compliance with the function requirements specification, project plans, and project specifications
 - 11. Provide operation and maintenance manuals for the SCADA system
 - 12. Provide archived system configuration files for disaster recovery purposes
 - 13. Post Start-Up Services to ensure operation of the facility after initial start-up and for "As-Built" documentation functions
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS (NOT USED)
- 1.04 REFERENCE STANDARDS (NOT USED)
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 CONTROL SYSTEM INTEGRATOR QUALIFICATIONS
 - A. The Integrator shall be engaged full time in the design and manufacturer of PLC based control systems. The Integrator shall have documented experience in the municipal water and wastewater market.

- B. The Integrator shall be of a sufficient size that the proposed project will utilize less than 20% of the total programming and project management man-hours that the Integrator has available in any given month. The Integrator shall provide a staffing plan that documents how this requirement will be meet.
- C. The Integrator shall maintain a local office within 250 driving miles of the project site for the past two years. This office shall be equipped with programming equipment, and staffed with a minimum of 3 programmers and 5 service technicians capable of performing routine maintenance, trouble shooting, and field programming changes on the proposed PLC control systems. See Section 1.2., part H. for further requirements.
- D. The control system Integrator shall be an Allen-Bradley authorized "Solution Provider".
- E. The control system Integrator shall have a panel shop located at their main facility and shall be able to obtain a UL listing for control panels.
- F. The control system Integrator shall stage a factory acceptance test for the control system at their local office. During this test, the Integrator shall demonstrate the complete operation of the control system including any field I/O and network connections.
- G. Project Staffing:
 - 1. The Owner and Engineer shall review and approve all proposed project staffing to be used by the Integrator on the project. The project staffing report shall include all proposed sub-consultants to be utilized on the project. Once the staffing is approved and accepted, changes in the project staff will not be allowed. (The Integrator's project staffing plan shall be submitted to the Owner within 30 days of the Notice to Proceed.)
 - 2. Project Manager:
 - a. The Project Manager shall be a registered professional engineer licensed in the State of Texas and shall oversee all aspects of the control system project.
 - b. The Project Manager shall have documented experience in the design and construction management of instrumentation / control and electrical systems. This experience shall include emergency power systems, variable frequency drive systems, harmonic correction, voltage drop and load flow analysis, breaker coordination, motor starters, conduit & conductor installation, and PLC / HMI programming.
 - c. The Project Manager shall be located in the Integrators local office.
 - d. The Project Manager shall be the primary contact for the Owner and Engineer.
 - e. The Project Manager shall personally meet with the Owner and Engineer to review the shop drawing submittals.
 - f. The Project Manager shall be onsite monthly to attend meetings with the Owner, Engineer, and Contractor.
 - g. The Project Manager shall be on site during the start-up and testing period for the proposed control system.
 - h. Prior to power being applied to any control devices, the Project Manager shall send the Owner and Engineer a letter indicating that the Project Manager has reviewed the work and is satisfied that the installation is in accordance with

the Shop Drawings, equipment manufactures recommendations, good industry practices, and the NEC.

- 3. Programmers:
 - a. All Programmers shall be Graduate Engineers or Computer Science Majors with a 4 year college degree. As a minimum, all programmers shall have 5 years of experience in PLC and HMI programming.
- 4. Service Technicians:
 - a. All Service Technicians shall have a minimum of a 2 year Associates Degree in some field related to computers or electrical maintenance.
 - b. All Service Technicians shall have a minimum of five years of experience in PLC systems and HMIs.
 - c. All Service Technicians shall be capable of programming the proposed PLCs and shall pass a proficiency test to the Engineer's satisfactions.
 - d. All Service Technicians shall have experience troubleshooting: motor starters, PLC, computer, and HMI systems.
 - e. Service Technicians shall show proficiency in using the following equipment: volt meters, oscilloscopes, PLC programming software, HMI configuration tools
- 1.11 PLC / HMI PROGRAMMING
 - A. All PLC code shall be written in "Ladder Logic" style.
 - B. All PLC / HMI code shall be supplied to the Owner with fully descriptive comments. All HMI code shall be supplied to the Owner with fully descriptive screen and tag data.
 - C. The Integrator shall provide the Owner with a flow chart of all PLC code as well as a written algorithm of the code's functions.
 - D. The Owner will define the graphic standards to be used for all HMI equipment. All control panel screens will be custom.
 - E. The Integrator shall provide the Owner with an I/O map of all process variables in the PLC.
 - F. Ladder logic shall have real name labels in each control loop such as Pump 1 hand off auto, seal failure, over temperature, pump clock 1, etc, for each program.
 - G. All PLC code shall be the property of the Owner.
 - H. The Contractor shall provide three copies of all commented PLC, HMI, and Operator Interface code/script/screen layouts to the Owner in electronic format prior to acceptance by the Owner. Any documentation not containing symbol information or comments will not be considered acceptable.

1.12 TRAINING

A. The Contractor shall require that the instrumentation and control system Integrator plan, schedule and conduct a thorough and comprehensive training program designed to meet the general and specific needs of the Owner's operating and maintenance personnel. The training program shall include training on the completed system at the Owner's site.

- B. Training, except that conducted during start-up and maintenance visits by service technicians, shall be conducted by professional training specialists employed by the instrumentation and control system Integrator.
- C. The Integrator shall submit a training syllabus to the Engineer as a shop drawing for approval.
- D. As a minimum the Integrator shall provide ten, eight hour classes for the treatment facility operators for operational training.
- E. As a minimum the Integrator shall provide five, eight hour classes for the treatment facility maintenance staff on maintenance and troubleshooting.
- 1.13 ADDITIONAL REQUIREMENTS
 - A. The Integrator shall include 200 hours of additional onsite PLC programming and screen development for use during the construction of the control system in their base bid. These hours shall be used as directed by the engineer or the Owner to add additional screens and control loops as required.
- PART 2 HUMAN-MACHINE INTERFACE (HMI)
 - A. The Human-Machine Interface software for the lift station HMI. The Owner shall be responsible for providing all necessary licenses, drivers, and required network and software packages as required, for the configuration as detailed in the project plans. The Integrator shall be required to provide the necessary HMI screens to monitor and control the equipment installed in this project. The Integrator shall be required to submit the proposed HMI screens to the Engineer and Owner for approval a minimum of eight weeks prior to the factory testing.
 - B. Min. Screens as follows:
 - 1. Lift station
 - 2. One per station
 - 3. System overview
 - 4. Alarms
 - 5. Reports
 - C. The 3D graphics for the new HMI screens shall be dynamic and shall closely represent the process units such that the operators can easily transition and navigate between screens.
 - D. All available functions represented on the screens shall be easily identified. The Operator shall not be required to navigate multiple levels of menus to perform a control function. (No more than 2 key strokes to get to any major screen from any screen and no more than 3 key strokes to get to any screen or popup from any screen.)
 - E. All alarms generated by equipment installed on the project shall be displayed in the alarm summary page. The Integrator shall coordinate with the Owner when configuring the system alarms and subsequent actions. All alarms shall be configured for

FactoryTalk Alarm and Events (using alarm blocks in the Controller and CPR 9 or greater of Factory TalkView SE). The use of HMI alarm tags will not be allowed unless sufficient reason is submitted and approved.

PART 3 EXECUTION

3.01 CONTRACTOR'S RESPONSIBILITY

A. The Contractor shall coordinate the control system Integrator during construction, testing, start-up, calibration and acceptance of the instrumentation and control system. The Contractor is responsible for a complete and fully operational instrumentation and control system.

3.02 GENERAL INSTALLATION

- A. The Instrumentation and control system, peripherals, and accessory equipment shall be installed in accordance with the equipment manufacturer's instructions and located as shown on the Contract Drawings or as approved by the Engineer.
- B. The Contractor shall coordinate the installation, placing and location of system components, their connections to the process components, panels, cabinets and devices, as required to complete the work subject to the Engineer's approval. The Contractor shall be responsible to insure that all field wiring for power and signal circuits between existing devices, the proposed control system are correctly done in accordance with best industry practice to insure a satisfactory functioning installation

3.03 TEST AND ACCEPTANCE

A. The Engineer and Owner shall witness Acceptance Tests, On-site Operability Tests and System Acceptance Tests.

3.04 INSTALLATION

- A. All equipment and devices for the instrumentation and control system shall be installed in the locations shown on the drawings, in accordance with the manufacturer's recommendations, and in compliance with the requirements of these specifications.
- B. The control system Integrator shall work with Allen-Bradley to test, calibration and start-up all instrumentation and control equipment. The control system Integrator shall provide the necessary time to ensure all systems are installed properly, tested and fully operational.

3.05 FIELD ACCEPTANCE TESTS

- A. No power shall be activated to any part of the instrumentation and control system until the Engineer receives a written certified statement by the system supplier that the installation is complete and ready for energizing. The Contractor is responsible for proper coordination and scheduling, and any damage to the instrumentation and control system.
- B. After the installations are completed, the Contractor through the control System Integrator, shall test each component of the instrumentation and control system. After all systems are operating properly, the Contractor shall notify the Engineer and

demonstrate the full operation of the system. The Contractor shall make all necessary adjustments and correct or replace faulty equipment to the satisfaction of the Engineer.

3.06 FIELD CALIBRATION

- A. All instrumentation and controls shall be calibrated in the presence of the Engineer in accordance with the manufacturer's instructions to the accuracy specified.
- B. The Contractor shall provide field calibration as necessary until the project is considered Substantially Complete by the Engineer.

3.07 MAINTENANCE AND CALIBRATION PERIOD

- A. During the first year of operation after substantial completion of the entire project, the Contractor shall provide maintenance and calibration services for the newly installed instrumentation and control systems. All maintenance and calibration activities shall conform to the manufacturer's requirements and shall be provided by a certified technician. This work shall include all labor, tools, equipment, materials and all other expenses at no additional cost to the Owner. Calibration and maintenance shall be performed every three months at a minimum
- 3.08 SOFTWARE STANDARDS AND COVENANTS PHASE
 - A. The System Integrator shall be responsible for following the Owner's software standards and design covenants.
- 3.09 AS-BUILT DOCUMENTATION
 - A. The control system Integrator shall provide the Owner with a complete set of AutoCAD 2020 control drawings for the project. These drawing shall include loop sheets, system block diagrams, starter schematics, and PID drawings. The drawings shall indicate all wiring numbers.
 - B. The Integrator shall provide detailed documentation of all computer code developed for this project. This documentation shall include but not be limited to: flow charts, written descriptions, comments in PLC code, and MMI scripting. All software and code developed for this project shall be considered property of the Owner. No password protected code or documentation shall be accepted.
 - C. All As-Built documentation shall be provided in both paper and electronic formats

PROCESS LOOP DESCRIPTION

PART 1 GENERAL

- 1.01 SCOPE OF WORK
 - A. This section describes the general function and disposition of each primary process loop. The Control System integrator shall provide additional functions as needed to adhere to good control and engineering practices. These additional functions shall be GENERAL
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS (NOT USED)
- 1.04 REFERENCE STANDARDS (NOT USED)
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 CONTROL SYSTEM DESIGN PHILOSOPHY
 - A. The control system for the proposed lift stations shall incorporate the design philosophies as described in the section. It shall be the responsibility of the System Integrator to ensure that these philosophies are engrained in proposed plant control system.
 - B. The control system shall be implemented, such that the operator has the ability to perform local control ('HAND' operation) in the event of a RTU failure.
- PART 2 PRODUCTS
- 2.01 GENERAL SYSTEM DESCRIPTION
 - A. This project includes the following: lift station RTU and interface with the Owner's existing SCADA system.
 - B. The Owner's SCADA System shall allow the operator to monitor the operating status of all equipment located at the lift station that is connected to the RTU.
 - C. The Owner's SCADA System shall allow the operator to manually operate any piece of equipment connected to the RTU remotely.

- D. The RTU shall allow the operator to easily change the operating setpoints of any piece of equipment that is automatically operated by the RTU via the Owners SCADA System. The setpoint ranges shall be hard coded such that the operator may not be allowed to enter a setpoint that allows the equipment to operate out of the range or limits set forth by the equipment manufacturer.
- E. The PLC based RTU shall alarm the system operator when any equipment that was called to run by the RTU fails to start or stops running for any reason.
- F. The RTU shall alarm the system operator whenever an alarm condition is present on any piece of equipment connected to the RTU.
- G. Overall requirements of the system operation & Control System are as described in the loop descriptions in these specifications and in the contract drawings.
- H. The Control System Integrator shall provide all Software necessary a complete and fully operations RTU controlled pump station.
- I. The Owner will do all of the required program and HMI modifications to the existing SCADA System for connection of the proposed RTUs.

2.02 ALARM CONDITIONS

- A. All alarm conditions for the proposed equipment shall:
 - 1. Notify the operator of the system alarms by providing an audible and visual notification
 - 2. Report back to the Owner's SCADA system.

2.03 LIFT STATION CONTROL

The Control System shall control the Pumps in a tradition pump down operation. The RTU shall start the pumps at the level that is remotely set by the operator through the Owner's SCADA system. The pumps shall shutdown at to the "All Pumps Off Level". The RTU shall alternate the pumps each cycle in order to even the wear of the pumps.

Setpoint Name	Description / Use
Low Low Level Alarm	Alarm Setpoint
High High Level Alarm	Alarm Setpoint
All Pumps Off Level	
Lead Pump On Level	
Lag Pump On Level	
2nd Lag Pump On Level	

- A. The RTU shall be the primary control system for the lift station.
- B. The System Integrator shall configure the level transmitter as the backup control system for the lift station.
- C. The RTU shall monitor and alarm the following conditions to the operator:
 - 1. Pump H-O-A selector switch not in Auto
 - 2. Pump motor overload

- 3. Pump motor thermal overload
- 4. Pump motor moisture
- 5. Power Fail Relay
- 6. Motor Starter / Soft Start Fail
- 7. Pump not running when called to run
- D. The RTU shall use the Power Fail Relay inputs to protect the pump motors.
- E. The RTU shall communicate with the owner's SCADA system via radio. The communication shall be based on a communication block as formatted per the owner's requirements.
- 2.04 LIFT STATION MONITORING
 - A. The RTU shall monitor all equipment connect to the RTU and report the status of said equipment back to the Owner's SCADA System:
 - 1. Flow Meters
 - 2. Generators
 - 3. Transfer Switches
 - 4. Power Fail Monitors
 - 5. Odor Control System
 - 6. Backup Level Control Levels
 - 7. RTU Enclosure Temperature
 - 8. Pump Run Times
 - 9. Starter Status
 - 10. H-O-A Selector Switch Status
 - B. The RTU shall keep track of the pump run hours in the RTU

PART 3 EXECUTION (NOT USED)

CONTROL PANEL CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Supplier shall furnish, test, and startup all furnished electrical control panels and control system components related to their furnished equipment.
- B. Specifically included are the following control panels:1. All Control Panels
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. Product Data: For each type of product supplied. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
 - B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - C. Additional Shop Drawing Requirements:
 - 1. Point to Point Wiring Drawings.
 - 2. Process Loop Drawings
 - 3. Fabrication and nameplate legend drawings
 - 4. Internal wiring schematic drawings.
 - 5. Systems schematic drawings illustrating all components being supplied complete with electrical interconnections.
 - 6. Computer input/output lists and a written description of the control strategy to be applied.
- 1.04 REFERENCE STANDARDS (NOT USED)
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS (NOT USED)
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR CONTROL PANELS

- A. All control panes shall be constructed in accordance with the following standards: National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), Underwriter Laboratories (UL), Nation Fire Protection Association (NFPA), and Instrumentation Systems and Automation Society (ISA)
- B. All control panels shall be constructed in a UL approved production facility and bear all applicable UL labels for panel construction.
- C. The completed panel shall be factory tested prior to shipment. Field installation by the Contractor shall consist only of setting the panel in place and making necessary pneumatic and/or electrical connections.
- D. All control panels shall be designed to operate at the service voltage as indicated in the project plans.
- 2.02 CONTROL PANEL ENCLOSURES
 - A. All control panels and associated hardware shall be constructed of 316L stainless steel.
 - B. All interior components shall be mounted with stainless steel hardware and shall be clearly identified with plastic identification nametags. The tags shall be white with black lettering.
 - C. All control panels shall be NEMA 4X construction with a 3-point steel latching mechanism and padlocking stainless steel handles. Latch rods to have rollers for easier door closing.
 - D. Door shall be provided with heavy gauge continuous stainless steel hinges.
 - E. All control panels shall be constructed of 14 gauge stainless steel. Control panels shall also include a 10 gauge mild steel sub-panel mounted on collar studs for equipment mounting.
 - F. All control panel seams shall be continuously welded and ground smooth.
 - G. Exterior control panel doors shall be removable by pulling the stainless steel hinge pin.
 - H. Data pockets shall be provided on all interior panel doors. The equipment supplier shall provide laminated schematics in each pocket for the associated control panel.
 - I. All cabinets shall be sized to accommodate the equipment required plus 25% spare space.
 - J. All control panels shall be provided with a mild steel dead front panel capable of protecting the operator from a bolted fault within the control panel with the outer door open.

2.03 CONTROL PANEL COOLING REQUIREMENTS

- A. NEMA 4X air conditioners and sun shields shall be supplied as required to keep the equipment mounted inside the control panels operating within the manufacturers operating temperature requirements. (The air conditioner unit shall not exchange the air inside the control panel with the air outside the control panel. The unit shall be coated to provide environmental protection.)
- B. The manufacturer of the control panels and cabinets shall provide all necessary cooling/heating equipment required to maintain temperature and humidity within the operating requirements of all equipment located within panels and cabinets. Coordination for electrical/mechanical connection is the responsibility of the Contractor. At the time of submittals, the Contractor shall submit calculations indicating that such requirements have been met.
- C. All exterior control panels designed for exterior mounting shall be provided with equipment rated for 60° Celsius or provided with air conditioners.
- 2.04 PLC EQUIPMENT
 - A. See plan sheet for schedule
- 2.05 PLC / MMI PROGRAMMING
 - A. All PLC code shall be written in either "Ladder Logic" style.
 - B. All PLC / MMI code shall be supplied to the owner with fully descriptive instruction and rung comments. All HMI code to be supplied to the owner with fully descriptive screen and tag data.
 - C. The control panel manufacture shall provide the owner with a flow chart of all PLC code as well as a written algorithm of the codes functions.
 - D. The owner will define the graphic standards to be used for all MMI equipment. The control panel manufactures shall assume that all control screens will be custom.
 - E. The control panel manufacture shall provide the owner with an I/O map of all process variables in the PLC.
 - F. All PLC code shall be the property of the owner.
 - G. The Contractor shall provide three copies of all commented PLC, HMI, and Operator Interface code/script/screen layouts to the Owner in electronic format prior to acceptance by the Owner. Any documentation not containing symbol information or comments will not be considered acceptable.
- 2.06 CONTROL PANEL WIRING
 - A. Wiring, where required, shall be general-purpose open type, neatly bundled and laced or installed in plastic wiring troughs. Wire shall be stranded No. 16 AWG minimum, with thermoplastic insulation rated for 600V and 90 degrees C.

- B. All equipment mounting backboards shall be provided with nonmetallic slotted ducts. All nonmetallic slotted ducts shall have spare space equal to 40% of the depth of the duct.
- C. Wiring colors shall be as follows:
 - 1. All ungrounded AC conductors operating at the supply voltage shall be "Black"
 - 2. All ungrounded AC control conductors operating at voltage less than supply shall be "RED"
 - 3. All ungrounded DC control conductors shall be "Blue"
 - 4. All ungrounded AC control conductors or wires that remain energized when the main disconnect is in the "OFF" position shall be "Yellow"
 - 5. All grounded AC current carrying conductors shall be "White"
 - 6. All grounded DC current carrying conductors shall be "White with a Blue stripe"
 - 7. All grounded AC current carrying conductors that remain energized when the main disconnect is in the "OFF" position shall be "White with a Yellow stripe"
 - 8. All ground conductors shall be "Green"
 - 9. A wiring color code legend shall be mounted inside the control panel door.
- D. All wires entering and leaving all panels shall be terminated at barrier type terminal strips with integral surge protection. All terminals shall be identified and labeled per the Owner's standard naming conventions. It shall be the Supplier's responsibility to coordinate with the Owner for the accepted naming conventions. (All terminal strips shall be designed for #12 AWG, XHHW-2, 90 degree C field wiring for terminations.)
- E. No terminal strip may be located closer than 8" from any side or bottom of the control panel. This is designed to allow for adequate wire bending radius for field terminations.
- F. All wiring shall be clearly marked with an identification number consistent with the wiring schematic.
- G. Devices mounted on the enclosure door or interior dead front panel shall be run in spiral wrap to avoid pinch points when opening and closing the enclosure door(s) or interior panels
- 2.07 SURGE PROTECTION
 - A. All analog I/O signals shall be protected by loop powered isolators manufactured by Phoenix Contact or Engineer approved equal.

2.08 PANEL MOUNTED DEVICES

- A. Indicating lights to be LED heavy duty, push-to-test type, oil tight, industrial type designed for 24V DC operation. Lights shall be by the same manufacturer as the MCC equipment being supplied on the project– Allen-Bradley Bulletin 800T 30.5mm or approved equal.
- B. Momentary pushbuttons to be heavy duty, oil tight, industrial type with full guard and momentary contact rated at 10 Amps continuous at 120 VAC. Legend plates shall be factory engraved as required. Pushbutton shall be by the same manufacturer as the MCC equipment– Allen-Bradley Bulletin 800T 30.5mm or approved equal.

- C. Selector switches, on/off and H.O.A. to be heavy duty, oil tight, industrial type with contact rated at 120 VAC, 10 amps continuous service. Legend plates shall be factory engraved as required. Switches shall be by the same manufacturer as the MCC equipment Allen-Bradley Bulletin 800T 30.5mm or approved equal.
- D. Current to voltage converters, 4-20mAdc to 1-5Vdc shall be as manufactured by Phoenix Contact or Engineer approved equal.
- E. D.C. power supplies shall be as manufactured by PLC Manufacturer, Phoenix Contact, or approved equal and shall be sized for 1.5 times the application requirements. (No open power supplies will be allowed.)
- F. All relays shall Allen-Bradley. 24V DC Ice Cube Relays. All relays to be DPDT. Provide hold down clamps for all relays.
- G. All circuit breakers shall be 22K AIC rating.
- H. All starters shall be NEMA rated (no IEC devices). All motor speed controllers shall have the following capabilities: remote start/stop, status output, running output, and remote speed.
- I. Power distribution blocks shall be block style distribution blocks manufactured by Ferraz Shawmut or Engineer approved equal. All distribution blocks shall be provided with polycarbonate safety covers to provide dead front protection. The safety cover shall have a test prod hole for testing purposes
- J. Fuse blocks/holders shall be UL style fuse blocks manufactured by Ferraz Shawmut or Engineer approved equal.
- K. General purpose fuses shall be Ferraz Shawmut UL Power Fuse style or Engineer approved equal. Unless otherwise noted the fuse rating and type shall be determined based on the equipment (which the fuse is protecting) manufacturer's recommendations for overcurrent protection.
- L. Semiconductor fuses shall be Ferraz Shawmut Amp Trap series fuses or Engineer approved equal. Unless otherwise noted the fuse rating and type shall be determined based on the equipment (which the fuse is protecting) manufacturer's recommendations for overcurrent protection.
- M. All control transformers shall be sized to provide 25% spare capacity. The transformer connections shall be provided with protective covers to guard against accidental contact, and the transformer shall be provided with primary and secondary fusing per the manufacturer's recommendations.
- N. Each control panel shall be provided with a series connected suppression filter system to protect the programmable logic controller and instrumentation power from high-frequency noise and electrical transients. The suppression filter shall be a current technology LoadGuard or Engineer approved equal.
- O. All intrinsically safe barrier relays shall be UL listed and shall be manufactured by Warrick or Engineer approved equal.

P. Pilot lights shall be provided for each starter located inside the control panel. The lights shall be as follows: Red (Run), Green (Off), Amber (Fault).

2.09 MISCELLANEOUS

- A. Engraved laminated plastic nameplates shall be furnished for each front panel mounted instrument. The Contractor shall coordinate with the Owner for nameplate color and naming conventions. All instruments and components shall be tagged on rear with embossed plastic tape labels.
- B. No pneumatic tubing shall be installed inside the control panels.

PART 3 EXECUTION

3.01 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall coordinate the work of the service personnel during construction, testing, and acceptance of the work.
- B. The Contractor shall receive final approval on all panel, enclosure, and equipment layouts by the Engineer prior to fabrication or installation.

3.02 QUALITY ASSURANCE

- A. All control panels shall be factory tested and certified prior to releasing for shipment. The testing shall consist of but not limited to the following:
 - 1. Point to point testing of all wiring prior to application of power
 - 2. The intended supply voltage shall be applied to the control panel and all components shall be tested for proper operation and calibration.
 - 3. The programmable logic controller and operator interface code shall be loaded, and each shall be tested for functionality.
 - 4. All components shall be checked to confirm that each device has been installed per the plans and specifications as well as the Manufacturer's recommendations.
 - 5. The enclosure shall be inspected for defects and shall be repaired or replaced if necessary.
 - 6. All labeling and identification tags shall be verified and be clean and visible.
- B. An Electrical Engineer, registered in the state of Texas, shall be required to document the results of the control panel testing. The documentation shall contain the results of the tests listed above as well as any rework items and subsequent repairs that were required prior to shipment. In addition he/she must certify this document prior to the release for shipment. Prior to shipment all one copy of the applicable documentation shall be placed in the drawing pocket of each enclosure, and three copies shall be sent to the Engineer.

3.03 INSTALLATION

A. All equipment and devices for the work shall be installed in the locations shown on the drawings, in accordance with the manufacturer's recommendations, and in compliance with the requirements of these specifications.

- B. The Contractor shall be responsible for coordinating the installation of all equipment in the proposed locations with all other trades performing work on the project that may be affected.
- 3.04 FINAL INSPECTION
 - A. Include all changes and/or alterations in the control panels prior to final inspection and acceptance by the owner.
 - B. Any changes and/or alterations in the Control Panels shall be reflected/updated in all Control Panel Schematics prior to acceptance by the Owner. This includes all electronic copies delivered to the Owner.

FIELD INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes the following:
 - 1. Electromagnetic Flow Meters
 - 2. Pressure Gauges

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 16.
- 1.03 SUBMITTALS
 - A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
 - B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
 - 1. Sensor housing, NEMA rating.
 - 2. Power requirements.
 - 3. Sensitivity ranges.
 - 4. Mounting requirements.
 - C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connections.
 - D. Coordination Drawings, including plumbing/connection plans and sections drawn accurately to scale. Submit with Shop Drawings. Show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
 - E. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
 - F. Maintenance data for units to include in the operation and maintenance manual specified in Division 1 and in Division 15 Section "Basic mechanical Requirements".
- 1.04 REFERENCE STANDARDS (NOT USED)
- 1.05 QUALITY ASSURANCE
 - A. Electrical Component Standard: provide components that comply with NFPA 70 and that are listed and labeled by UL where available.

- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS
 - A. Project Altitude: Base air ratings on sea-level conditions.
 - B. Operating Temperature: 35 degrees F to 100 degrees F.
 - C. Environment: Wastewater.
- 1.07 DELIVERY, STORAGE AND HANDLING
 - A. Deliver units as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
 - B. Lift and support units with the manufacturer's designated lifting and covering.
- 1.08 MAINTENANCE/SPARE PARTS
 - A. Furnish any spare parts that are expected to be replaced within a 1-year period in sufficient quantity to keep monitoring equipment operating for a minimum period of one year.
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 PROJECT CONDITIONS
 - A. Field Measurements: Verify dimensions by field measurements. Verify clearances for installation.
- 1.11 COORDINATION AND SCHEDULING
 - A. Coordinate with the Owner for the location of mounting areas.
 - B. Coordinate the Dissolved Oxygen System with process equipment manufacturer for exact placement.
- PART 2 PRODUCTS
- 2.01 MANUFACTURERS & SUPPLIERS
 - A. Manufacturer's: Subject to compliance with requirements list in the project specifications.
 - B. Supplier's: Suppliers shall be located within a 100-mile radius of the project.

Manufacturer:	Endress & Hauser	
Model No:	Endress & Hauser Proline Promag 10W	
NEC Classification	Meter to be Class I, Div. 2	
Water Resistance	IP68 (NEMA Type 6P)	
Measured Error:	+/- 0.2%	
Temp Range:	-5 to 50 degrees Celsius	
Liner:	Hard Rubber	
Pressure Class:	ANSI B 16.5 Class 150	
Headloss:	0 PSI	
Display Range:	5 digits with sign and units	
Signal Current:	0 to 3000 nA	
Signal Output:	4 to 20 mA	
	Provide a remote totalizing display with 4-20mA output and 120V AC input power. NEMA 4X construction by E&H	
Display:	LC, Backlit, 4 lines, 16 characters each	
	Mount on a Stainless Steel Unistrut rack with a Sun Shield. Face instrument North to reduce sun exposure	
Size:	As shown on mechanical drawings	

2.02 ELECTROMAGNETIC FLOW METER

2.03 PRESSURE GAUGES

Manufacturer:	Ashcroft
Model No:	Type 1009, Grade 1A
Туре:	Liquid Filled
Display:	4 1/2"
Housing:	Stainless Steel
Pressure Range:	Equal to 1.5 times shutoff head of pumps supplying system, but not greater than 3.0 times shutoff head.

2.04 WARRANTY

- A. The equipment shall be warranted for a period of one year after the installation.
- B. Components failing to perform as specified by the engineers, or as represented by the manufacture, or proven defective in service during the warranty period, shall be replaced, repaired or satisfactorily modified by the manufacture without cost to the Owner when returned to the manufacture.

2.05 WORKMANSHIP

- A. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer to conform with the contract documents. The installation shall be accomplished by workmen skilled in this type of work.
- 2.06 LIGHTNING PROTECTION
 - A. Each electronic transmitter shall be provided with a Phoenix PLUGTRAB TVSS device for both the power and the 4-20 mA signal in a NEMA 4X stainless steel hinged junction box adjacent to the transmitters.
- PART 3 EXECUTION

3.01 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout".
- C. Demonstrate operation of products specified in this Section. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each product.
- 3.02 INSTALLATION
 - A. Install according to manufacturer's written instructions.
 - B. Install units with clearances for service and maintenance.
 - C. Contractor shall install required electric conduit and cables for all field instruments. Each electric field instrument shall be supplied with 3#12 in a 1"C to the nearest power panelboard unless otherwise indicated on the project drawings. In addition, 2-2#18 AWG shield pairs of signal wire in a 1"C shall be provided to the nearest PLC plant control panel unless otherwise shown on the project drawings.
 - D. Each pump shall be provided with a discharge pressure gauge. The discharge pressure gauge shall be connected to the piping system prior to the pump check valve. Each pressure gauge shall be supplied with a stainless-steel isolation valve and pipe nipple for connection to the tapped pipe.
 - E. All pressure transmitters shall be installed using a stainless-steel isolation valve and stainless steel pipe nipple. Provide Stainless Steel diaphragm seals for all pressure transmitters.
 - F. All transmitters shall be provided with sun/rain hoods.
- 3.03 CONNECTIONS
 - A. Electrical: Conform to applicable requirements in Division 16.

B. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation and electrical connections, and to report results in writing.
- B. Contractor shall install all equipment and related accessories before having the manufacturer's field service. If additional trips are required due to incorrect installation, Contractor shall pay for the costs for the field services.

3.05 DOCUMENTATION

A. Manuals: Provide the Owner with original copies of the installation, operation, maintenance, and calibration manuals as provided with the equipment. In addition, provide the original warranty cards and product literature. Copies of this information shall not be accepted.

INSTRUMENTATION - GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section specifies the requirements for Brownsville Public Utility Board. The requirements outlined in this section address general hardware, software, and services necessary to provide the control functions specified. More detailed requirements of specific functions and components are presented in other Division 17 sections that follow.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. General
 - 1. Submittals shall be made in accordance with the requirements of this section, the requirements of Section 01300, and the requirements of individual Division 17 Sections. The CONTROL SYSTEM INTEGRATOR shall submit via the GENERAL CONTRACTOR to the OWNER technical data and drawings for all equipment, materials, software, assemblies, and installations prior to fabrication and installation. All submittals shall be made in accordance with the submittal procedures and requirements in Section 01300 Submittals and Review. The CONTROL SYSTEM INTEGRATOR shall be responsible for the accuracy and completeness of all submittals, including information and drawings provided by other suppliers or subcontractors providing equipment, materials, software or services to the CONTROL SYSTEM INTEGRATOR.
 - 2. In all instances in which submittals are required by the Specifications, the CONTROL SYSTEM INTEGRATOR shall not proceed with the associated work until the submittal has been Successfully Reviewed.
 - 3. Each submittal shall be complete, with all required information provided together at one time, and submitted in a sequence that allows the OWNER to have all of the information necessary for checking and approving a particular document at the time of the submittal. The specified timing requirements for each submittal are minimum requirements. The CONTROL SYSTEM INTEGRATOR shall be responsible for planning and making all submittals as necessary to avoid delays or conflicts in the work.
 - 4. See Section 01300 for requirements on quantities of documents to be submitted for review. Once documents have been successfully reviewed, the CONTROL SYSTEM INTEGRATOR shall issue them in the quantities shown in the table labeled "Documentation Requirements".
 - B. Submittal Categories: Project submittals are divided into the following general categories:
 - 1. Design Submittals
 - 2. System Documentation Submittals
 - 3. Testing Submittals

- 4. Training Submittals
- 5. The following paragraphs define the specific contents of each of these submittal categories. The requirements outlined for each of these submittals shall apply to all equipment and services specified in all sections of Division 17. Additional submittal requirements may be found in specific sections of Division 17.
- C. Design Submittals
 - 1. Hardware Submittal
 - a. Product information shall include, but not be limited to: catalog cuts, data sheets, performance surveys, test reports, equipment lists, material list, diagrams, pictures, and descriptive material. The product information shall cover all items including mechanical devices, mounting components, wiring, terminal strips, connectors, accessories, and spare parts. The submittal information shall show the standard and optional product features, as well as all performance data and specifications.
 - b. Prior to commencement of manufacture (or shipment for stock items), the CONTROL SYSTEM INTEGRATOR shall submit for review product information for all equipment and material specified in Division 17, or required to support equipment, or systems specified in Division 17. Specific requirements for the form and content of product information submittals are included in the individual section that defines the equipment requirements.
 - 2. Connection Diagrams
 - a. Connection diagrams shall show the placement, labeling and wiring of components within panels, cabinets and consoles. Components shall be shown arranged in the physical layout (not necessarily to scale) as it would appear to a person servicing the equipment. Connection diagrams shall include all internal wiring of the panel; this shall include AC and DC power wiring and multi-conductor cables from PLC card to rewired termination blocks. Wires shall be shown as a continuous line between their termination points. Each wire label designation shall be shown. The wire label designations on each end of a single wire must be identical. All wire termination point numbers shall be shown. Each wire color shall be shown. Signal and DC circuit polarities shall be shown. All jumpers, shielding and grounding details shall be shown.
 - b. The CONTROL SYSTEM INTEGRATOR shall submit connection diagrams for all new panels, cabinets and consoles. Connection diagrams shall be Successfully Reviewed prior to the start of panel assembly.
 - 3. Panel Fabrication and Layout Drawings
 - a. Panel fabrication drawings are scaled drawings that shall show the physical dimensions, materials, and construction of panels, cabinets, terminal boards, consoles, or other electrical or mechanical equipment enclosures. These drawings show the physical arrangement and mounting of all components in or on a panel, terminal board, cabinet, console, or enclosure. These drawings show the physical dimensions, and the space and mounting requirements of mechanical, electrical, control and instrumentation devices or pieces of equipment. Other information provided may include ventilation requirements, locations of connections, weight, and paint color, material and dry film thickness.
 - b. As a minimum, panel fabrication and layout drawings shall include a bill of materials; front, back, and section views; the locations of all components to

be mounted in or on the panel, cabinet, console, enclosure or assembly; drawing scale; nameplate engraving schedule; and structural materials and supports. All drawings shall be scaled. Overall dimensions and minimum clearances shall be shown. Sufficient detail shall be included to demonstrate material choices, outward appearance, construction methods, and seismic force resistance.

- c. Complete shop drawings shall be prepared and submitted for all panels, cabinets, and consoles which are custom fabricated or modified for this project. The OWNER shall have the right to make modifications to the interior and exterior layouts of panels as part of the shop drawing review. No additional compensation will be provided to the CONTROL SYSTEM INTEGRATOR for changes that result. The CONTROL SYSTEM INTEGRATOR shall include in his bid price one redesign of the panel layout to incorporate the OWNER's modifications to the locations of specified components in or on each panel, cabinet, console, or enclosure.
- 4. Interface Cables: The CONTROL SYSTEM INTEGRATOR shall submit for review interface cable pin-out/cable makeup diagrams. This includes all network cables, radio to PLC/RTU cables, computer to PLC cables and printer cables. Submittal shall include copies of the actual hardware documentation. All cables shall either be standard cables from the manufacturer or custom-made, without the use of gender changers, 9-25 pin converters, null modem adapters, etc.
- 5. Interconnection Diagrams: Interconnection diagrams shall include typical wiring diagrams for each type of product. Wires shall be shown as a continuous line between their termination points. Each wire label designation shall be shown. The wire label designations on each end of a single wire must be identical. All wire termination point numbers shall be shown. Each wire color shall be shown. Signal and DC circuit polarities shall be shown. All jumpers, shielding and grounding details shall be shown.
- 6. Installation Drawings: Installation drawings shall show installation arrangements for all provided equipment, mounting and anchoring details, conduit entries into cabinets, and Control System electrical power supply distribution conduit and wiring. Data sheets and/or catalog cuts for mounting devices, anchors, wire and other incidental installation materials shall be included.
- D. System Documentation Submittals
 - 1. Operation and Maintenance (O&M) Manuals: The CONTROL SYSTEM INTEGRATOR shall supply O&M manuals for all the equipment and software provided. The O&M manuals shall be developed for personnel at the level of electronic technician. The O&M manuals shall describe the detailed preventive and restorative procedures required to keep the equipment in good operating condition. An O&M manual or a set of manuals shall be furnished for all deliverable hardware, including OEM equipment. O&M manuals for OEM equipment shall contain original printed materials, not copies, and may be provided in the manufacturer's original format. Manuals shall be provided in electronic format. The O&M manuals shall contain the following information:
 - 2. Instruction Manual
 - a. The manual shall be written in English and illustrated in detail to the component level, including assemblies, subassemblies, and components. It shall contain a detailed analysis of each major component so that

maintenance personnel can effectively service, inspect, maintain, adjust, troubleshoot, and repair the equipment.

- b. Each manual shall include a Table of Contents, arranged in systematic order, and shall be divided into the following sections:
 - i. Introduction: The purpose of the manual, special tools and equipment, and safety precautions.
 - ii. General Information and Specifications: A general description of the equipment item, and specifications of its major components.
 - iii. Listings: Supplier's name, address, and telephone number. Each product shall include name, address, and telephone number of subcontractor, or installer, recommended maintenance contractors, local source for replacement parts.
 - iv. Theory of Operation: The relationship of assemblies, subassemblies, components and interchangeability of components, and explanation and analysis of their functions to the smallest board replaceable components.
 - v. Software: Listing and explanatory text for any software or firmware.
 - vi. Operation Procedures: The locations and functional descriptions of all controller indicators, or CRT displays.
 - vii. Troubleshooting: A list in tabular format of all symptoms, probable causes of malfunction or improper operation, and probable remedies to the smallest board replaceable components.
- 3. Preventive Maintenance Instructions: These instructions shall include all applicable visual examinations, hardware testing, and diagnostic hardware/software routines. Instructions on how to load and use any test and diagnostic programs and any special or standard test equipment shall be an integral part of these procedures.
- 4. Corrective Maintenance Instructions
 - a. These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction. These guides shall explain how to use on-line test and diagnostic programs for all devices and any special test equipment, if applicable.
 - b. The corrective maintenance instructions shall include:
 - i. Explanations for the repair, adjustment, or replacement of all items, including printed circuit cards. Schematic diagrams of electrical, mechanical, and parts location, illustrations, photographs, and sectional views giving details of mechanical assemblies shall be provided as necessary to repair or replace equipment. Typical signal waveforms, logic levels, bit patterns, etc., shall be included. For mechanical items requiring field repair, information on tolerances, clearances, wear limits, and maximum bolt-down torques shall be supplied. Information on the loading and use of special off-line diagnostic programs, tools, and test equipment as well as any cautions or warnings which must be observed to protect personnel and equipment shall be included.
 - ii. A list of test equipment and special tools required.
 - iii. A list of all abbreviations and circuit symbols used.

- iv. Warranties, bonds and maintenance records, including proper procedures in the event of failures and instances which might affect the validity of warranties, bonds, or contracts.
- v. A parts catalog enumerating every part to the lowest of card replaceable components. The description shall include component symbol, description, ratings, accuracy, manufacturer's name and address, manufacturer's part number, commercial equivalents, and quantity per assembly or subassembly. The parts catalog shall identify the appropriate locations of the parts and shall group each component by assemblies or subassemblies within each subsystem so that each component can be identified as being part of the next larger assembly.
- vi. A list of recommended spare parts that includes all parts necessary to maintain and repair control system components. The list shall identify the specific part or model number, description, manufacturer's name and address, commercial equivalents, unit price, lead time for delivery, and recommended quantity. The spare parts list shall indicate which components (by model and serial number) have been provided with the delivered system as part of the spares inventory.
- 5. Drawings
 - a. O&M Manual drawings (with the exception of those provided by third-party manufacturers) shall not be larger than 11-inches by 17-inches and shall be clearly legible when reproduced using conventional office copying machines. Originals shall be provided for all third-party O&M Manual materials. One reproducible of the O&M Manual drawing original must be supplied for each O&M Manual drawing larger than 11 inches by 17 inches, and must satisfy all drawing requirements specified herein. Those preprinted O&M Manual drawings which are not acceptable, or which must be modified or corrected to show the actual as-built design, shall be redrawn as new specially-prepared shop drawings. Acceptable equipment manufacturer's drawings incorporated into equipment operating and maintenance manuals need not be duplicated or removed from the manuals.
 - b. The CONTROL SYSTEM INTEGRATOR shall furnish drawings in paper and latest AutoCAD electronic format.
 - c. Each O&M Manual shall be bound in 8 1/2" x 11 inch 3-ring side binders with commercial quality hardback, cleanable plastic covers. Maximum of 3" binder size. O&M Manuals shall be submitted in electronic format per Specifications Section 01250 Paragraph 1.05, Part H.
 - d. Binder covers shall contain the printed title "Operation and Maintenance Instructions", "Brownsville Public Utilities Board", "Brownsville Lift Station Rehabilitation".
 - e. The manuals shall be internally subdivided with permanent page dividers with tab titling clearly printed under reinforced laminated plastic tabs.
 - f. Each volume shall have a Table of Contents, with each product or system description identified.
- E. Software Manuals: The CONTROL SYSTEM INTEGRATOR shall supply Original OEM O&M Manuals in lieu of developing specific O&M Manuals. Only that equipment which lacks proper O&M Manuals would the CONTROL SYSTEM INTEGRATOR be responsible for supplementing the product literature.
- F. Record Documents

- 1. After successful Site Demonstration Test, the CONTROL SYSTEM INTEGRATOR shall submit for review the Record Documents (as-built) for all equipment and software installed by the CONTROL SYSTEM INTEGRATOR. All documents which have changed because of the engineering changes, contract changes, or error or omission shall be updated and the revised documentation provided.
- 2. The CONTROL SYSTEM INTEGRATOR shall furnish complete as-built sets of:
 - a. Source tapes, disk pack(s) or other storage media for all custom programs
 - b. Loadable and executable object disk pack(s) of the software systems
 - c. All previously delivered documents, with as-built updates
 - d. OEM standard documentation.
- 3. These media shall include the operating systems, all programs necessary for the operation as well as maintenance of the System, and all programs supplied by the CPU/Microprocessor manufacturers, such as assembler, loaders, editors, compilers and diagnostics.
- 4. The documentation as outlined in this portion of the document, in conjunction with other documentation specified elsewhere in this document, shall be sufficient to allow the OWNER to reconfigure or make additions or deletions to the System without assistance from the CONTROL SYSTEM INTEGRATOR.
- G. Testing Documentation Submittals
 - 1. System test plan requirements are included in Section 17000 part 3.01.
 - 2. Test procedures requirements are included in Section 17000 part 3.01.
 - 3. Test reports requirements are included in Section 17000 part 3.01.

1.04 REFERENCE STANDARDS

A. This subsection references the latest revisions of the following standards. They are a part of Division 17 as specified and modified. In case of conflict between the requirements of this section and those of the listed standards, the requirements of this section shall prevail.

Standard	Title
ANSI/NEMA ICS 6	Enclosures for Industrial Control and Systems
API RP550	Manual on Installation of Refinery Instruments and Control Systems Part I – Process Instrumentation and Control
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S50.1	Compatibility of Analog Signals for Electronic Industrial Process Instruments
ISA S51.1	Process Instrumentation Terminology
1.05 QUALITY ASSURANCE

- A. The CONTROL SYSTEM INTEGRATOR shall perform all work necessary to select, furnish, configure, customize, debug, install, connect, calibrate, and place into operation all hardware and software specified within this section and in other sections as listed in Article 1.02, Related Work.
- B. Actual installation of the system need not be performed by the CONTROL SYSTEM INTEGRATOR's employees; however, the CONTROL SYSTEM INTEGRATOR shall provide the on-site technical supervision of the installation.
- C. The CONTROL SYSTEM INTEGRATOR shall furnish equipment which is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS
 - A. Corrective Maintenance
 - The CONTROL SYSTEM INTEGRATOR shall provide the services of factorytrained service technicians for the purpose of performing corrective maintenance on all system hardware and software. The period of coverage for each piece of equipment shall begin upon initial equipment purchase or manufacture and shall continue for two years after final acceptance or until expiration of the manufacturer's warranty, whichever period is longer.
 - 2. The CONTROL SYSTEM INTEGRATOR shall provide a 24-hour, 7-day/week service hotline for telephone notification of system malfunctions. Within 2 hours from notification by the OWNER of defective Control System operation, the CONTROL SYSTEM INTEGRATOR shall have a gualified service representative establish telephone contact with the OWNER's maintenance personnel to discuss short-term corrective measures. If it is not possible to correct the defective operation as a result of the telephone contact, the CONTROL SYSTEM INTEGRATOR shall have a qualified service representative at the location of the installed Control System within 24 hours from initial notification. The service representative shall perform all necessary inspections and diagnostic tests to determine the source of the defect and to establish a corrective action plan. The corrective action plan shall be developed such that the defect is corrected as quickly as possible and with the least impact on the operation of the OWNER's facilities. Prior to beginning any repair or replacement procedure, the CONTROL SYSTEM INTEGRATOR shall review the corrective action plan with the OWNER in order to inform him of the planned course of action and to allow assessment of any impact that course of action might have on the operation of the OWNER's facilities. At OWNER's option, OWNER maintenance personnel may participate in any corrective maintenance procedures.
 - 3. If possible, the service representative shall effect replacement or repair of the defective component before leaving the site using replacement parts from the spare parts inventory delivered with the system. Otherwise, the corrective action plan shall include a detailed schedule for the planned course of action. Once the

defect has been corrected, the corrective action plan shall be updated indicating the source of the defect and specific corrective action taken. A copy of the updated corrective action plan shall be delivered to the OWNER on the day the work is performed. Any spares from the onsite supply of spares used by the CONTROL SYSTEM INTEGRATOR in correcting the system malfunction shall be replaced within 15 days.

- 4. If 24-hour response time is not provided, or other corrective maintenance requirements are not met by the CONTROL SYSTEM INTEGRATOR, the OWNER shall have the right to obtain corrective maintenance from other sources and charge the CONTROL SYSTEM INTEGRATOR reasonable costs of the alternative maintenance services, including parts, labor, travel, and subsistence.
- 5. The OWNER, at the OWNER's option, may elect to employ its own maintenance staff to locate and remove a defective component. In this case the OWNER will return the defective component to a repair location as instructed by the CONTROL SYSTEM INTEGRATOR. The CONTROL SYSTEM INTEGRATOR shall repair or replace the defective component and return the properly working unit to the OWNER within 15 days.
- 1.09 WARRANTY/EXTENDED WARRANTY (NOT USED)
- 1.10 CONTROL SYSTEM INTEGRATOR (CSI) QUALIFICATIONS
 - A. Qualifications
 - 1. The CSI shall be a licensed engineering firm in the State of Texas.
 - 2. The CSI shall hold a Rockwell Solution Partnership Certification
 - 3. The CSI shall be engaged full time in the design and manufacturer of PLC based control systems. The Integrator shall have documented experience in the municipal water and wastewater market.
 - 4. The CSI shall be of a sufficient size that the proposed project will utilize less than 20 percent of the total programming and project management man-hours that the Integrator has available in any given month. The Integrator shall provide a staffing plan that documents how this requirement will be meet.
 - 5. The CSI shall maintain a local office within 250 driving miles of the project site. This office shall be equipped with programming equipment, and staffed with a minimum of 3 programmers and 2 service technicians capable of performing routine maintenance, trouble shooting, and field programming changes on the proposed PLC control systems.
 - 6. The CSI shall have a panel shop located at their main facility and shall be able to obtain a UL listing for control panels.
 - 7. All software development for this project shall be done in the local office.
 - 8. The CSI perform a factory acceptance test for the control system at their local office, and notify the Owner of such time so the Owner has the opportunity to attend. During this test, the Systems Integrator shall demonstrate the complete operation of the control system including any field I/O and network connections. The test shall also have actual dynamic loads provided for each Across-the-Line Starter circuit connected to the control system.
 - B. Project Staffing

- 1. Project Manager
 - a. The Project Manager shall be a registered professional Engineer licensed in the State of Texas a and shall oversee all aspects of the control system project.
 - b. The Project Manager shall have documented experience in the design and construction management of instrumentation / control and electrical systems. This experience shall include emergency power systems, variable frequency drive systems, harmonic correction, voltage drop and load flow analysis, breaker coordination, motor starters, conduit & conductor installation, and PLC / HMI programming.
 - c. The Project Manager shall be the primary contact for the Owner and Engineer.
 - d. The Project Manager shall be on site during the start-up and testing period for the proposed control system.
- 2. Deputy Project Manager The Deputy Project Manager shall be a Graduate Electrical Engineer or Computer Science Major with a 4-year college degree. The Deputy Project Manager shall fill for the PM when the PM is not available and shall act as the Project Manager's delegate. For Companies where the registered engineer is not located within 100 miles of the project site, the Deputy PM will be allowed to serve as the onsite representative.
- 3. Programmers All Programmers shall be Graduate Engineers or Computer Science Majors with a 4 year college degree. As a minimum, all programmers shall have 5 years of experience in PLC / SCADA / HMI programming.
- C. Service Technicians
 - 1. All Service Technicians shall have a minimum of a 2-year Associates Degree in some field related to computers or electrical maintenance.
 - 2. All Service Technicians shall have a minimum of five years of experience in PLC /SCADA / HMI systems.
 - 3. All Service Technicians shall have experience troubleshooting: motor starters, PLC, SCADA, and HMI systems.
 - 4. Service Technicians shall have proficiency in using the following equipment: volt meters, oscilloscopes, PLC programming software, HMI configuration tools

1.11 DEFINITIONS

- A. The definitions of terminology used in the Division 17 specifications or in any Section referencing Division 17, shall be as defined in ISA Standard S51.1 unless otherwise specified. Where terms used are not defined in ISA 51.1 or in these specifications, ANSI/IEEE Standard 100-1984, ANSI/ISA S50.1 or other ISA standards shall apply.
 - 1. Signal Circuit: Any circuit operating at less than 80 volts AC or DC.
 - 2. Control Circuit: Any circuit operating at 24 volts AC or DC or more, whose principal purpose is the conveyance of information and not the conveyance of energy for the operation of an electrically powered device.
 - 3. Power Circuit: Any circuit operating at 12 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
 - 4. Two-Wire Transmitter: A transmitter which derives its operating power supply from the signal transmission circuit and therefore requires no separate power supply

connections. As used in this specification, two-wire transmitter refers to a transmitter which provides a 4 to 20 milliampere current regulation of signal in a series circuit with an external 24 volt direct current driving potential and a maximum external circuit resistance of 600 ohms.

- 5. Electrical Isolation: Pertaining to an electrical node having no direct current path to another electrical node. As used in this specification, electrical isolation refers to a device with electrical inputs and/or outputs which are galvanically isolated from ground, the device case, the process fluid, and any separate power supply terminals, but such inputs and/or outputs are capable of being externally grounded without affecting the characteristics of the device or providing a path for circulation of ground currents. The terms "galvanic isolation," "electrical isolation", "isolation", or similar terms shall mean electrical isolation whenever used in Division 17, or whenever used in specifications for electrical control and instrumentation equipment in any other Divisions of these contract documents. Unless otherwise specified, electrical isolation for analog signal devices shall be rated 250 volts AC continuous; and 1500 volts AC for one minute, in accordance with ANSI/IEEE C39.5-1974.
- 6. Panel: An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term "panel" in these contract documents shall be interpreted as a general term which includes flat panels, enclosures, cabinets and consoles.
- 7. Data Sheets: Data sheets as used in this specification shall comply with the requirements of ISA S20.
- 8. Field: When used to refer to locations at the treatment facility or in the transmission system, shall mean all outdoor locations, as well as all process and equipment areas. Unless otherwise specified, all areas shall be considered "field" locations except for: administration and other office areas; control rooms; motor control centers and other electrical equipment rooms; dedicated HVAC rooms; and maintenance buildings.
- 9. Control Room: An environmentally controlled room intended for housing digital control equipment, computers, large control panels, etc., and generally intended to be regularly occupied by operators.
- 10. Division 17 Work: Whenever the terms "Division 17 work", "specified under Division 17" or "provided under Division 17" are used, they shall be interpreted as referring to all materials, labor, products, services, systems, etc., specified in Sections 17000 through 17999, inclusive, unless equipment shown or specified is clearly labeled as being provided under other parts of the contract.
- 11. UPS: <u>Uninterruptible Power Supply</u>.
- 12. HMI: <u>H</u>uman-<u>M</u>achine-<u>I</u>nterface. The control system hardware and software associated with providing the CRT-based interface between system users and the control system.
- 13. PLC: <u>Programmable Logic Controller</u>. Field installed unit which monitors and controls devices, located within the plant. The PLCs contain all logic necessary to monitor and control the system process located at the PLC location.
- 14. SCADA: <u>Supervisory Control and Data Acquisition</u>.

- 15. RTU: <u>Remote Terminal Unit</u>. Field installed unit which monitors and controls devices, located away from the plant at remote locations. The RTUs contain all logic necessary to monitor and control the system process located at the remote location.
- PART 2 PRODUCTS

2.01 INFORMATION ON DRAWINGS

- A. The following information is indicated on the drawings:
 - 1. Loop diagram on flow sheet for each control loop. Diagrams are schematic in nature and intended only as a guide to work to be performed.
 - 2. Approximate location of primary elements, instrument panels and final control elements.
 - 3. Approximate location of instrumentation power junction boxes for instrument electrical power connection.
 - 4. Location of electrical distribution panel boards for instrument electrical power.
 - 5. Location of equipment having alarms and equipment status contacts.
 - 6. Location of equipment being controlled by system.
 - 7. General layout of instrument cabinets.
 - 8. Instrument installation details.
- B. The following information is not shown on drawings but shall be the responsibility of the CONTROL SYSTEM INTEGRATOR to determine, furnish and coordinate with other divisions, based upon systems specified. Show this information on project record drawings.
 - 1. Instrument loop drawings per ISA S5.4 minimum, desired and optional items.
 - 2. Location of electrical distribution panel boards supplying power to any device supplied under this contract.
 - 3. Detailed enclosure and instrument panel layouts, fabrication details and wiring diagrams.
 - 4. Detailed system configuration.
 - 5. Raceway and cable routing for instrumentation wiring.

2.02 OPERATING CONDITIONS

- A. Ambient Conditions: Provide equipment suitable for ambient conditions specified. Provide system elements to operate properly in the presence of radio frequency fields produced by portable RF transmitters with output of five watts operated at 24 inches from instruments; in the presence of plant telephone lines, power lines and electrical equipment; and in the presence of digital data transmission systems.
- B. Field Locations: Field equipment may be subjected to ambient temperatures from -5 to 50°C with direct radiation, relative humidity from 0 to 100 percent with condensation.

C. Power Supply: Power supply will be 117 volts AC, single- phase, 60-hertz commercial power. Voltage variations will be at least plus or minus 8 percent. Certain loops shall have integral power supply as indicated on the drawings.

2.03 TRANSIENT AND SURGE ISOLATION

A. Protect all power and communication and transmission/ receiving circuitry from any surge, including spikes up 1,000 volts peak and surges with a rise time of less than one microsecond. Use a combination of current limiting resistors, zener diodes, gas tube surge arresters and a fusible link which melts and shorts the surge to ground before the device circuitry is affected. Provide protection adequate for personnel safety, which will prevent an erroneous output, change in calibration or failure of component other than fuse or fusible link.

2.04 SPARE PARTS

A. During the system warranty period, the CONTROL SYSTEM INTEGRATOR is expected to make system repairs by initially replacing the defective component with one from the spares inventory. The CONTROL SYSTEM INTEGRATOR shall then replace the spare component

2.05 SPECIAL TOOLS

A. CONTROL SYSTEM INTEGRATOR shall supply one of each type of special hand tool required to open or operate equipment, to remove or replace replaceable parts, remove or replace cable connectors, or to make required operational or maintenance adjustments. A special hand tool is any tool not readily available from local retail hardware stores.

2.06 TEST EQUIPMENT

- A. The CONTROL SYSTEM INTEGRATOR shall provide a complete list of all tools, test equipment, and commercial software programs necessary for the proper maintenance of the system. This list shall contain the quantity recommended, model number, description, cost, and name and address of supplier.
- 2.07 MATERIALS AND EQUIPMENT
 - A. Materials: Material shall be new, free from defects, and of the quality specified. All instruments with the same specification shall be from the same manufacturer.
 - 1. Provide equipment of solid-state construction utilizing second source semiconductors, unless otherwise specified. Derate components to assure dependability and long-term stability. Provide printed or etched circuit boards of glass epoxy, hand or wave soldered, of sufficient thickness to prevent warping. Coat printed circuit boards in field-mounted equipment with plasite 7122, or approved equal, to protect against corrosion. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers. Do not insert components of specially selected values into standard electronic assemblies to meet performance requirements. Use parts indicated in instruction manuals, replaceable with standard commercial components of the same description without degrading performance of completed assembly. Do not use silver edge connectors or pins.

- 2. Use test equipment and instruments to simulate inputs and read outputs suitable for purpose intended and rated to an accuracy of at least five times greater than the required accuracy of device being calibrated. Such test equipment shall have accuracies traceable to the National Bureau of Standards as applicable.
- 3. Make equipment located in hazardous areas suitable for applicable classification by use of explosion-proof housings or equipment and barriers approved as "intrinsically safe" by either UL or FM. Locate barriers in cabinets at hazardous area boundaries. Use dual barriers in loops in order to prevent a grounding loop at the barrier.
- 4. Provide all special tools necessary for operation, maintenance and calibration of all (instruments) devices, subsystems, and systems supplied.

2.08 SPECIAL PROJECT REQUIREMENTS

- A. As a part of this contract, the instrumentation systems CONTROL SYSTEM INTEGRATOR shall coordinate with all the sub-systems suppliers and manufacturers, during bidding, construction, testing, installation and start-up phases of the project. The coordination is to assure that the instruments, and sub-systems are in compliance with the specifications and the central controls, and that the tie-ins and the interface signals are provided as required.
- B. The calibration, testing and start-up of all the instruments shall be done by the manufacturer's field technician/engineer in the presence of the OWNER. The CONTROL SYSTEM INTEGRATOR shall provide a list of all manufacturers whose technician will perform this work. The CONTROL SYSTEM INTEGRATOR shall also provide a certified calibration report stating that each instrument has been installed per manufacturer's recommendations and per these specifications.
- PART 3 EXECUTION
- 3.01 OVERVIEW
 - A. The CONTROL SYSTEM INTEGRATOR is responsible for the following areas:
 - 1. Acquisition and installation of all the hardware, software and instrumentation as defined in this specification and drawings.
 - 2. Perform the Factory Demonstration Test as defined paragraph 3.02, B.
 - 3. Provide start-up installation services for the PLCs.
 - 4. Provide start-up installation services for the HMI.

3.02 SYSTEM TEST REQUIREMENTS

- A. General Requirements:
 - 1. The Control System shall undergo a comprehensive system test process to demonstrate that the system performs as an integrated unit to meet the requirements of this specification. The CONTROL SYSTEM INTEGRATOR, as a normal course of system development, shall conduct all element, subsystem, and system tests necessary to ensure the proper operation of the control system at various stages of system development. This type of testing will normally be not witnessed; however, the OWNER and ENGINEER reserve the right to witness these tests if concerns arise about the progress of system implementation.

- 2. Two formal, witnessed tests shall be conducted on the Control System:
 - a. Factory Demonstration Test (FDT) (PLC. HMI, OIU)
 - b. I/O Point Checkout, TERMINATION checkout and HMI checkout
- 3. The following paragraphs describe the requirements for each of these formal tests.
- B. Factory Demonstration Test (FDT)s
 - A FDT and verification for all equipment, software, and associated documentation shall be performed prior to system, subsystem, or major components shipment. The tests shall be performed to verify that the equipment is manufactured and assembled correctly, is operating as designed, and is in compliance with the contractual requirements for the deliverables. The tests shall be performed to verify that the software and hardware will meet the functional and performance requirements of this document.
 - 2. City (three persons) and the ENGINEER (one person) will witness these factory tests. The supplier of the control system shall provide the following for City and the ENGINEER.
 - a. Notification four weeks in advance of the tests
 - b. Air travel to/from the test facility
 - c. Lodging in a hotel
 - d. Ground transportation
 - e. Meals
 - f. Above items if retesting must be performed to obtain satisfactory results
 - 3. The FDT shall demonstrate compliance to each explicitly stated requirement in the specification. CONTROL SYSTEM INTEGRATOR shall use the Excel spreadsheet program to build a FDT cross reference table that lists each specification paragraph that imposes a uniquely identifiable technical requirement. CONTROL SYSTEM INTEGRATOR shall add to the format a data field for the FDT test number of the test that is going to demonstrate compliance with the requirement. A second version of the table, sorted by test number, shall also be printed. This will make it possible to select any specification paragraph and identify the FDT test that should demonstrate the feature. The version ordered by test number can be used to verify the completeness of each test and shall be used during the FDT to check off the features demonstrated.
 - 4. The FDT shall include the following:
 - a. Equipment Test and Verification: The FDT for the equipment (hardware) shall include individual end-item verification and integrated tests of all hardware. These tests shall include visual inspection verification and running the standard hardware diagnostic programs, plus all special diagnostic programs used by the CONTROL SYSTEM INTEGRATOR to demonstrate that the hardware integration task has been completed.
 - b. System Functional Test: The functional test shall exercise every specified system function and shall include, but not be limited to, the following:
 - i. Rigorous exercising of all devices both individually and collectively.
 - ii. Verification of proper scanning and data acquisition of status and data points.
 - iii. Demonstration of all redundant functions and components.
 - iv. Demonstration of all required data base management functionality.

- v. Demonstration of all required software support utilities.
- vi. Demonstration of all system diagnostics, both on-line and off-line.
- 5. Support Software Tests: The FDT for the support software shall include the following, as a minimum:
 - a. Demonstration of system editing capabilities including the addition and deletion of points in an PLC; the addition, deletion, and modification of HMI displays, the addition, deletion and modification of report formats, the addition, deletion, and modification of control strategies, and the modification of the database and all data base parameters.
 - b. Demonstration of the editing of all system parameters including timers, intervals, etc.
 - c. Demonstration of utility software facilities, including assembling, compiling, appending, and executing new programs. On-line program debug facilities shall also be demonstrated.
- C. I/O Point Checkout
 - 1. An I/O point checkout shall be performed after all equipment is shipped and installed in the field. The tests shall be performed to verify that the equipment has been installed correctly. The tests shall be performed to verify that the software and hardware will meet the functional and performance requirements of this document.
 - 2. The OWNER and the ENGINEER will witness these factory tests.
 - 3. The I/O point checkout shall demonstrate the proper operation of all the field points affected by the installation of the equipment provided by this contract.
 - 4. The CONTROL SYSTEM INTEGRATOR shall provide an I/O list for each PLC provided, and a test plan that indicates how the verification will occur.
 - 5. The I/O Point Checkout shall include, but not limited to, the following:
 - a. Exercise each discrete input. Each state shall be verified at an Operator Workstation.
 - b. Exercise each analog input. Each input shall be verified at 0, 50 and 100% range of the instrument. Linearity of the signal shall be verified. Each value shall be verified at the Operator Workstation.
 - c. Exercise each discrete output. Each state shall be initiated from the Operator Workstation. If necessary, the associated equipment shall be placed into a "safe" state such that the activation of the output will not damage the equipment or cause a safety hazard.
 - d. Exercise each analog output. Each output shall be verified at 0, 50 and 100% range of the instrument. Linearity of the signal shall be verified. Each value shall be initiated and verified at the Operator Workstation.
 - e. Unless constrained by the operation of the plant, or due to safety reasons, all testing should include the actual equipment, and not use simulates signals.
 - 6. I/O Point Checkout shall be coordinated with City's HMI developer.

3.03 INSTALLATION AND STARTUP

A. Field Testing: Field testing and start-up shall consist of a sequence of activities and tests conducted as the control system components are installed and integrated at the job site. Following is a description of the individual steps that are involved with field testing and cut-over.

- 1. PLC Checkout
 - a. Once the PLC network is operational to each PLC location, field installation and checkout of the PLCs will begin.
 - b. The field devices will be exercised by the CONTROL SYSTEM INTEGRATOR to demonstrate the field wiring has been terminated properly.
 - c. The next step of PLC checkout shall be an end-to-end (Operator Workstation to field termination) checks of every physical I/O point connected to the PLC.
 - d. Next, any control software associated with the PLC shall be activated and tested one-function at a time by the CONTROL SYSTEM INTEGRATOR and witness by the ENGINEER. When problems are found, the software configuration shall be "debugged" and the problem fixed by the CONTROL SYSTEM INTEGRATOR. When a problem is found, the appropriate tests shall be repeated after the problem is corrected by the CONTROL SYSTEM INTEGRATOR to verify proper operation. Once the control software in the PLC has been tested and debugged, that PLC shall remain online on the new control system.
 - e. Each PLC in the system shall be installed and tested using the procedure described above. A specific installation and start up plan shall be developed by the CONTROL SYSTEM INTEGRATOR prior to Factory Demonstration Test. The OWNER/ENGINEER will provide assistance as necessary in developing the start-up plan.
 - f. During the start-up phase, the CONTROL SYSTEM INTEGRATOR shall provide a minimum of 2 people on site full-time. OWNER will provide one person full-time in the control room (dedicated to testing activities), and one person in the field to support installation and testing activities. ENGINEER will provide testing support and inspection as required.

3.04 SYSTEM TRAINING

- A. Training Manuals:
 - 1. Comprehensive training manuals shall be provided for all training courses. The manuals shall be professionally written to present the course material in a format that is easy to comprehend. The manuals shall serve as teaching aids during presentation of the training classes and shall additionally serve as reference material after the training has been completed. It shall not be acceptable for the CONTROL SYSTEM INTEGRATOR to use Control System technical documentation solely as the training manuals since Control System documentation is generally not written in an instructional format. Portions of Control System documentation may be incorporated into training manuals provided that the overall manual achieves an instructional format.
 - 2. If the CONTROL SYSTEM INTEGRATOR proposes to use standard training manuals, these manuals shall be revised or appended to reflect Control System characteristics.
- B. Required Training Courses:
 - 1. Training courses shall be tailored to meet the specific needs of several distinct groups of OWNER personnel. The specific categories and number of personnel in each category are identified in the following paragraphs. Class sizes shall be restricted to the number of students that can easily be accommodated. Classes that involve extensive hands-on activities (such as operator training, maintenance

training, and software engineering) shall be limited to five students per class. Supervisor and overview courses may include up to ten participants. At least two sessions of each course shall be presented to satisfy class size restrictions and conflicts in OWNER personnel scheduling. Additional sessions shall be presented if required to accommodate the total number of personnel identified for each course. All training classes shall be scheduled Monday - Friday between 8:00 A.M. and 3:30 P.M. Each individual daily training session shall be a minimum duration of two hours and a maximum duration of five hours.

- 2. The intent of the training program is to provide the OWNER's personnel with comprehensive instruction in all subjects and areas necessary for the efficient configuration, troubleshooting and repair, maintenance, and use of the Control System. If the CONTROL SYSTEM INTEGRATOR's standard training curriculum includes courses in addition to those discussed below and which are necessary for the efficient configuration, maintenance, and use of the Control System, the CONTROL SYSTEM INTEGRATOR shall also provide these courses.
- 3. Following is a description of the categories of training to be provided.
- C. Operator Training
 - Training courses shall be presented that instruct the Control System operators in the efficient operation of all aspects of the Control System. The course material shall include not only the general operation of the Control System but also the operation of the specific Control System features require by this Contract. In particular, the operator training shall include instruction on the use of all operational functionality including, but not limited to alarm logging, trending, and the process displays, database, reports, and control software.
- D. Software Maintenance Training
 - 1. Training courses shall be presented that shall enable OWNER programmers to develop and maintain all aspects of the Control System software. Separate sessions shall be presented that deal with the following topics:
 - a. Process database development and modification
 - b. Historical database development and modification
 - c. Process display development and modification
 - d. Supervisory Control strategy development and modification
 - e. Report development and modification
 - f. Supervisory control development and modification
 - g. General software maintenance, including Control System backup, restoration, and archiving
 - 2. These courses shall address the procedures for the standard Control System software, plus material explaining the specific conventions and procedures used by the CONTROL SYSTEM INTEGRATOR in developing the new Control System applications. The courses shall provide instruction in techniques for developing and maintaining current comprehensive documentation for all applications.

3.05 SYSTEM APPLICATION CONFIGURATION

- A. Base System Configuration
 - 1. The CONTROL SYSTEM INTEGRATOR shall perform all system configuration activities necessary for the efficient operation of base control system functions. These activities shall include, but not be limited to: sizing of data tables and

queues, tuning of communication subsystem parameters, configuration of console control access definitions, setup of alarm subsystem parameters, redundancy setup, Ethernet management devices, etc. The CONTROL SYSTEM INTEGRATOR shall be responsible for all application programming of the PLC and HMI System.

END OF SECTION

SECTION 17300

PROGRAMMABLE LOGIC CONTROLLERS (PLC) REQUIREMENTS

- PART 1 GENERAL
- 1.01 SCOPE OF WORK
 - A. The CONTROL SYSTEM INTEGRATOR shall be responsible for providing a complete and operational system for the upgrade of the PLCs specified on the drawings. This PLC upgrade shall include hardware supply and installation.
 - B. The CONTROL SYSTEM INTEGRATOR shall provide the PLC hardware for the locations and requirements identified on the drawings. This shall include all PLC equipment, programming software, cables, connectors, PLC/PC network interface cards, rewired termination blocks, fiber optic cable, PLC data highway cable, PLC Ethernet equipment, and any other hardware and/or software to ensure a fully operational system.
 - C. The CONTROL SYSTEM INTEGRATOR shall provide installation services for the new PLCs. This service shall include removing the existing PLCs, installing the new PLC hardware, panel rewiring, I/O points check, and PLC testing.
 - D. The CONTROL SYSTEM INTEGRATOR shall provide two complete sets of as-built drawings for each PLC panel. These drawings shall be complete and accurate. All existing PLC improvement changes or modifications shall be shown on the as-built drawings. Each set of drawings shall be provided in both paper and electronic copy.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. Product Data:
 - 1. Submit vendor specification information along with a corrected copy of applicable specification form for each scheduled device specified in this section.
 - 2. Submit vendor specification information for each material and unscheduled device specified in this section.
- 1.04 REFERENCE STANDARDS (NOT USED)
- 1.05 QUALITY ASSURANCE (NOT USED)
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)

1.08 MAINTENANCE/SPARE PARTS

- A. The manufacturer shall provide the specified spare parts and/or tools as detailed below:
 - 1. One CPU of each type provided for the project configured to support the largest memory capacity used by the project.
 - 2. One of each type of I/O module used on the project.
 - 3. One of each type of network interface used on the project.
 - 4. One of each type of serial communication interfaces used on the project.
 - 5. One of each PLC power supply used on the project.
 - 6. One of each type of DC power supplies used on the project.
 - 7. One of each type of PLC rack used by the project.

1.09 WARRANTY/EXTENDED WARRANTY

A. The manufacturer shall provide an all-inclusive two (2)-year warranty.

1.10 TRAINING

- A. The manufacturer shall provide operating training and maintenance training. The Manufacturer's representative for inspection, supervision of installation, and training must be an experienced and competent technical (not sales) representative of the Manufacturer or Supplier.
- PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. All new PLCs shall be from one PLC manufacturer. PLC I/O modules shall be selected within one I/O product family.
- B. The panel layouts are for reference purposes only. In all cases, the CONTROL SYSTEM INTEGRATOR shall verify that their PLC supplied will fit and operate properly in the space provided.
- C. The PLCs provided shall be self-contained units capable of collecting data through electrically dry relay contacts, 4 to 20 mA DC analog, high level AC input signals. The PLCs shall also be capable of providing AC and DC control outputs, both momentary and latching, the contacts of which will be used by OWNER for remote control. The CONTROL SYSTEM INTEGRATOR shall provide all interposing relays that may be required to interface with the field AC signals.
- D. The PLCs shall be fully programmable in high level language and shall not require burning or etching of an EPROM for applications programs.
- E. The PLCs shall have stand alone calculation and control capability to perform the control logic functions using software and setpoints downloaded from the HMI.
- F. The CONTROL SYSTEM INTEGRATOR shall provide a new control power supply for the upgraded PLC system, if necessary. The new control power unit shall be installed BROWNSVILLE PUBLIC UTILITIES BOARD 17300-2 PROGRAMMABLE LOGIC CONTROLLERS REQUIREMENTS

in that PLC panel. The power unit shall be properly sized, installed, wired, checked and tested by the CONTROL SYSTEM INTEGRATOR.

- G. The CONTROL SYSTEM INTEGRATOR shall upgrade to the latest firmware version available from the equipment manufacture. Some example of the equipment needed firmware upgrade included but not limited to, PLC CPU modules, communication modules, Ethernet switches, I/O modules, communication gateway.
- 2.02 PLC DESIGN REQUIREMENTS
 - A. General
 - 1. Approved PLC manufacturers are as follows:
 - a. Allen-Bradley CompactLogix Platform (<u>www.ab.com</u>)
 - 2. The PLCs shall be solid-state electronic units of programmable design. The PLCs shall have a stand-alone restarting capability, i.e., no reloading of software programs for common logic, communications, and I/O processing at the PLC shall be required to resume operation following a loss of power. Therefore, all PLC basic programs shall be resident in battery backed up RAM with at least a five-year battery life.
 - 3. The PLCs shall be from one family of the manufacturer's product line. The product line used shall have an expected product life of over ten (10) years. Products nearing the end of their life cycle are not acceptable. CONTROL SYSTEM INTEGRATOR shall submit statement from manufacturer as part of the submittal.
 - 4. Solid state RAM shall be utilized for data buffering, change of state information, calculation parameters, and local control algorithms. A power failure indication shall be reported to the HMI after recovery from a power failure so that status initializing may be initiated by the HMI.
 - 5. All electronic components shall be mounted on plug-in printed circuit cards or modular subassemblies. Each printed circuit card and subassembly shall be model and serial numbered to uniquely identify it. Printed circuit cards shall be plug-in with quick disconnect field terminations.
 - 6. As a minimum the PLC CPU board shall have LED's for run, CPU fail, and low battery. The I/O modules shall have a power present LED.
 - 7. Equipment shall be sufficiently sturdy to withstand handling during shipment, placement, and start-up without damage or distortion.
 - 8. All switches and breakers and other current interrupting devices shall be nonarcing or hermetically sealed.
 - B. PLC Common Logic: Logic functions shall be implemented to receive data from and transmit data to the network, perform address decoding and error checks, and transfer data to and from the point input/output logic. In conjunction with the other PLC logic elements, the following functions shall be performed:
 - 1. Respond to commands for retrieving data

- 2. Prevent selection of more than one control point in a command sequence
- 3. Protect against single component failures causing a malfunction
- 4. Inhibit relays from being energized erroneously during the initial power-up period of the PLC
- 5. Provide a "power fail bit" which will be set upon commercial power loss or failure of the AC/DC power supply
- 6. Protect against a missing or failed logic card causing a malfunction, damage to other logic, or false transmission to the HMI
- 7. Protect against over/under voltage conditions from the OWNER's power source and/or the CONTROL SYSTEM INTEGRATOR's power subsystem from causing malfunction, damage to logic, or false transmissions to the HMI
- 8. Provide a "Change Summary" bit in the returned message to report status point changes on an exception basis (if all status is not returned on each scan)
- 9. Provide a real-time clock function
- 10. Each PLC shall continually monitor its operation and shall shut down in case of failure that would cause faulty solution of logic. A running PLC shall identify communication failures, I/O assembly errors, I/O module errors, and CPU battery failure and shall report such faults to the HMI. Faults shall also be reported to the PLC test set whenever it is connected to a PLC. In addition, a PLC trouble alarm shall activate a discrete output if any diagnostic detects a failure or upon CPU failure.
- 11. Provide for Peer-to-Peer communication between the new and existing PLCs. The new PLCs shall be able to exchange information with the existing Allen-Bradley PLCs using the Ethernet/IP protocol. Use of the HMI servers to exchange the data is not acceptable.
- 12. Provide empty I/O modules with a door cover for all PLC empty slots.
- C. PLC Hardware Requirements
 - 1. Shall communicate using Ethernet/IP protocol to the plant SCADA system.
 - 2. Shall communicate using an open standard, such as DeviceNet or Profibus, for the PLC I/O network.
 - 3. No DIP switches shall be used in the PLC system. All I/O addressing shall be done in software and all module configuration details shall be supplied by the PLC controller.
 - 4. Shall be capable of changing RAM battery without loss of program.
 - 5. The controller shall be 5069-L306ER.
- D. I/O Modules: The following types of process I/O interface capabilities shall be provided for the PLC:
 - 1. I/O modules shall be capable of being removed or replaced under power while the controller is running so as not to disturb other operating elements of the PLC system.
 - 2. I/O modules shall be software configurable.

- 3. I/O modules shall have the ability to define the failure mode of output modules. I/O modules shall be configured to turn all outputs off or zero (default state), go to predefined safe station, or hold the last value which the module received just prior to the watch dog timer expiration. This configuration information shall be set up on a point by point or channel by channel basis.
- 4. I/O modules shall have the capability of DeviceNet or Profibus communication by using a communication adaptor.
- 5. Discrete Input Requirements
 - a. The CONTROL SYSTEM INTEGRATOR shall be responsible for the PLC interface with the status and alarm contacts. For the "dry" contacts, the PLCs shall sense the states of these contacts by applying a voltage and observing the extent to which current flows. This voltage shall be obtained from a separate, isolated power supply furnished by the CONTROL SYSTEM INTEGRATOR. The voltage applied across the OWNER's open contacts shall be 24 VDC (nominal), or 110 VAC.
 - b. The exact input configuration shall be sized to meet the existing discrete input needs as specified on the drawings. The final configuration shall be from the standard product offering of the PLC manufacturer.
 - c. Discrete Input Module shall be 5069-IB16.
- 6. Discrete Output Requirements
 - a. The discrete output logic shall process the control commands received from the common logic. Any control scheme, in which a single message with undetected errors can cause a false command, shall be unacceptable.
 - b. Discrete output drive circuitry shall be designed such that any single logic component failure in the PLC does not energize a discrete output.
 - c. The exact output configuration shall be sized to meet the existing discrete output needs as specified on the drawings. The final configuration shall be from the standard product offering of the PLC manufacturer.
 - d. Discrete Output Module shall be 5069-OB8
- 7. Analog Input Requirements
 - a. Analog inputs from the transducers shall be 4-20 mA DC and all transducer power shall be provided by the dedicated 24 VDC + 10% power supply supplied by the CONTROL SYSTEM INTEGRATOR in the PLC Panel, or from an isolated output of the field device. The module shall be Bi-Polar with broken wire and Out of Range fault detection.
 - b. The exact input configuration shall be sized to meet the existing analog input needs as specified on the drawings. The final configuration shall be from the standard product offering of the PLC manufacturer.
 - c. Analog Input Module shall be 5069-IF8.
- E. PLC Power Supply:
 - 1. PLC power supplies shall be supplied with 110 VAC. PLC power supplies shall contain a "Power OK" LED.
 - Power supply shall be sized to support the full complement of cards installed on the rack. The CONTROL SYSTEM INTEGRATOR shall verify the power supply meets the requirements with all inputs and outputs fully-operational. For racks with unused slots, assume the empty slots contain the Analog Output module for power consumption purposes. All racks shall be extendable.

- F. PLC Communications: PLC Communications between the HMI servers and the PLCs shall be Ethernet compliant to IEEE 802.3. The transmission media for links that reside entirely within a building shall be copper Cat-6 cables. For any links that leave the building and are exposed to the external environment, transmission media shall be Fiber Optic terminated directly within the PLC panel. The CONTROL SYSTEM INTEGRATOR shall utilize either a communication card by PLC manufacturer or by a third party manufacturer certified by the PLC manufacturer. Each module shall be configurable with a unique IP network address.
- G. Remote I/O: The PLC shall support remote I/O racks connected to the PLC via an open protocol. The Remote I/O rack shall utilize the same rack and power supply as the PLC. Provide prefabricated remote I/O drop cables and connectors from the PLC manufacturer.

2.03 PLC SOFTWARE REQUIREMENTS

- A. The PLC shall be programmed to provide the overall system functions as described in Division 17 Specific functions which shall be performed via PLC-level software include, but are not limited to, the following functions described below. Software shall be the latest version of PLC manufacturer's programming package.
 - 1. General Requirements: The following are the requirements for the PLC programming software package.
 - a. Windows® Based
 - b. Be able to monitor and modify the PLC online
 - c. Contain a equation editor for complex algorithms
 - d. Have quick key support
 - e. Have On-line help menus.
- B. Diagnostics and System Programming. The PLC shall be programmed to provide the basic system functions as described in Division 17. Specific functions which shall be performed via PLC-level software include, but are not limited to, the following functions:
 - 1. PLC network configuration, including IP addressing.
 - 2. CPU module configuration.
 - 3. I/O module configuration.
- C. The PLC Programming Software shall be the full version of package provided by the manufacturer. It shall include all the latest service packs provided for the programming package by the manufacturer with discs, manuals, certificates in original packaging.
- D. The CONTROL SYSTEM INTEGRATOR shall make available to the OWNER all updates provided by the manufacturer for any provided software during the warranty period.
- 2.04 PROGRAMMING CABLES
 - A. CONTROL SYSTEM INTEGRATOR shall furnish two serial programming cables for each type of PLC/RTU to be programmed.

PART 3 EXECUTION

3.01 TEST REQUIREMENTS

- A. Factory Demonstration Test
 - The PLCs shall be integrated with the other components of the PLC system and tested as part of the system Factory Demonstration Test specified in Section 17000 In addition to the general system test requirements, each PLC shall be subjected to the tests described in this section with a written confirmation of the test results.
- B. Burn-In Test
 - 1. The CONTROL SYSTEM INTEGRATOR shall provide certification that the PLCs meet the ambient temperature requirements and have been tested to screen for infantile failures. If this certification is not provided by the PLC manufacturer, the CONTROL SYSTEM INTEGRATOR shall conduct the following test.
 - 2. All PLCs furnished shall be placed in a room having an ambient temperature of 60 degrees C with the PLCs connected to a data channel and to equipment simulating actual field equipment to be monitored or controlled. They shall remain energized at this temperature for a minimum period of 48 hours. During this 48-hour test period, the PLC shall have its various modes of operation exercised periodically. Any equipment failures shall be corrected and shall cause the test to be rerun in its entirety.
- C. PLC Functional Test
 - 1. Each PLC shall successfully pass the following functional tests to be performed in conjunction with the system Factory Demonstration Test:
 - a. A close and open operation on each control point, showing proper sequence of operations
 - b. Verify the proper operation of the digital outputs
 - c. A test showing that the proper indications are given at a Operator Workstation when one or more status input points change momentarily
 - d. A series of communications tests showing all message protocols and formats to which the equipment is designed to respond, and demonstrating that all error-detection or error-correction capabilities function properly, and that the equipment does not respond to erroneous commands
 - e. Telemeter readings of selected analog points to verify that the readings are within the specified accuracy when the inputs are at 0, 50, and 100 percent of full-scale
 - f. A test showing that as a result of a scan request from the HMI, all requested analog, indication, and alarm points are transmitted from the PLC
 - g. A test showing that the PLC successfully performs its various modes of operation while the power source for the PLC is varied over its specified range
 - h. A test verifying that all common equipment, wiring, files, and power supplies are provided for expansion of the PLC to the ultimate point count specified. This test shall also verify that the power supplies are capable of carrying the increased load for this expanded point count.

i. A test to verify the proper operation of the stand alone capabilities of the PLCs. This shall include configuration of the loops or downloading from the HMI and testing the actual control strategy with test signals.

END OF SECTION

SECTION 17400

INSTRUMENT PANELS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The CONTROL SYSTEM INTEGRATOR shall furnish, deliver, and install the control panels as shown on the drawings with power supplies, communications equipment, PLC Equipment, prewired termination blocks, incoming power surge suppression, and miscellaneous equipment to provide a fully functional system as shown on the drawings and specified herein.
- B. This section specifies connection wiring within panel and electrical accessories such as switches, pilot lights, relays, terminal blocks, and fuses, which are included in the panel.
- C. All work and products shall conform to the designs shown on the applicable Drawings, and shall comply with the provisions of this section. The control panel shall be factory wired. Panels and cabinet shall include all components indicated in the applicable Drawings, required to provide functions as specified in this section. Where specific requirements on the Drawings conflict with general design requirements in this section, the requirements shown on the Drawings shall prevail.
- 1.02 RELATED WORK (NOT USED)
- 1.03 SUBMITTALS
 - A. General: The CONTROL SYSTEM INTEGRATOR shall provide submittals as defined herein and as required in Section 17000. Submittals shall be required for all equipment supplied. For each panel, the CONTROL SYSTEM INTEGRATOR shall submit a certified factory (shop) test report before panel is shipped.
 - B. Elementary Control Diagrams: The CONTROL SYSTEM INTEGRATOR shall provide elementary control diagrams, using the ladder diagram format incorporating line number, operation function statement, contact location line number with an underline for a normally closed contact and a description of operation of each device. Label each contact, coil, and indicator with its function, as well as its number. Show terminals for field wiring. Show field wiring as dashed lines.
 - C. Connection Diagrams: Connection diagrams shall show the placement, labeling and wiring of components within panels and cabinets. Components shall be shown arranged in the physical layout (not necessarily to scale) as it would appear to a person servicing the equipment. Wires shall be shown as a continuous line between their termination points. The direction of entry to a wire bundle shall be shown. Wire lists and wireless diagrams shall not be accepted. All additions and deletions of devices and wires in existing enclosures shall be clearly shown. Each wire label designation shall be shown. The wire label designations on each end of a single wire must be identical. All wire termination point numbers shall be shown. All jumpers, shielding and grounding details shall be shown. Wire pairs shall be shown. Spare wires and termination points shall be shown.

1.04 REFERENCE STANDARDS

A. All materials and workmanship shall conform to the latest published applicable provisions of the following codes and standards:

Standards	Title
NFPA	National Electrical Code (NEC)
ANSI/NEMA ICS 1	General Standards for Industrial Controls and Systems
ANSI/NEMA ICS 2	Industrial Control Devices, Controllers, and Assemblies
ANSI/NEMA ICS 3	Industrial Systems
ANSI/NEMA ICS 4	Terminal Blocks for Industrial Control Equipment and Systems
ANSI/NEMA ICS 6	Enclosures for Industrial Controls and Systems
ANSI/NEMA 250	Enclosures for Electrical Equipment (1000 Volts maximum)
EIA RS-310-C	Racks, Panels, and Associated Equipment
ANSI-C-37.13	Low-Voltage AC Power Circuit Breaker (600 Volt Insulation Class)
ANSI/IEEE	Electrical Isolation for Analog Signal Devices C39.5-1974

- B. Unless otherwise specified, electrical equipment and material provided under this contract shall be listed and labeled for the purpose for which it is used by the Underwriters Laboratories, Inc. (UL). This requirement may be waived only if a UL listing is not available for the type of product.
- 1.05 QUALITY ASSURANCE
 - A. All equipment and accessories provided shall be the product of a manufacturer regularly engaged in manufacturing of this equipment whose products have been in satisfactory service for not less than three (3) years. Completed panels shall bear the UL label.
- 1.06 SYSTEM DESCRIPTION/DESIGN REQUIREMENTS (NOT USED)
- 1.07 DELIVERY, HANDLING AND STORAGE (NOT USED)
- 1.08 MAINTENANCE/SPARE PARTS
 - A. The manufacturer shall provide the specified spare parts and/or tools as detailed below:
 - 1. Ten relays of each type.
 - 2. Ten lights of each type.
 - 3. Ten surge protectors of each type.

- 4. Two power supplies of each type used.
- 5. Fifty fuses of each type used.
- 6. Two panel display of each type.
- 7. Two panel heater of each type.
- 8. Ten terminal blocks of each type used.

1.09 WARRANTY/EXTENDED WARRANTY

A. The manufacturer shall provide an all-inclusive two (2)-year warranty.

1.10 REQUIRED PANELS

- A. Panels shall conform to the layout shown on the Drawings, and be sized to accommodate the initial and future Input/Output (I/O) point counts listed shown on the Drawings. Enclosure sizing was based on typical industry-standard equipment. CONTROL SYSTEM INTEGRATOR shall advise the OWNER if a larger enclosure is required to meet these I/O counts using the actual equipment to be supplied by the CONTROL SYSTEM INTEGRATOR.
- B. For each PLC CPU, provide a minimum of one spare wired I/O card of each type: analog input (AI), analog output (AO), digital input (DI), and digital output (DO) or twenty percent spare wired I/O for each I/O type whichever greater.
- C. For each PLC remote I/O rack, provide a minimum of one spare wired I/O card of each type: analog input (AI), analog output (AO), digital input (DI), and digital output (DO) or twenty percent spare wired I/O for each I/O type whichever greater.
- 1.11 PANEL COMPONENT LAYOUT
 - A. The CONTROL SYSTEM INTEGRATOR shall generally follow the arrangements of components shown on the Contract Drawings. However, the CONTROL SYSTEM INTEGRATOR shall make adjustments as necessary to allow each component to be mounted as recommended by the manufacturer, to facilitate easy installation, removal and in-place maintenance of each component, and to allow normal operation of the component by operating and maintenance personnel. Component arrangements shall allow space for routing of wiring without kinking or bending around sharp edges, and for free flow of air around and through equipment, which requires ventilation for cooling.
- 1.12 TRAINING
 - A. The manufacturer shall provide operating training and maintenance training.
- PART 2 PRODUCTS
- 2.01 CONTROL PANELS
 - A. Physical and Miscellaneous Specifications The enclosures shall:
 - 1. Be NEMA 4X 316 stainless steel with 3 point latching handle.

- 2. Contain PLC/RTU equipment, surge arresters, circuit breakers, fuses, relays, transformers, terminal strips, nameplates, terminal labels, wire ducts, universal spiral wraps and any necessary parts for a complete systems as shown on the drawings and specified herein.
- 3. Be wall mount or free standing as shown on the drawings.
- 4. Allow expansion space to accommodate future system needs.
- 2.02 PANEL FABRICATION
 - A. Materials: The enclosure shall be made with 12 gauge minimum steel. Each shall be provided with a full length interior panel with adjustable mounting on both vertical sides to rails located at the top, bottom, and middle of the enclosure.
 - B. Acceptable manufacturers:
 - 1. Hoffman Engineering Company (<u>www.hoffmanonline.com</u>)
 - 2. Rittal (<u>www.rittal.com</u>)
 - 3. ENGINEER approved equal.
 - C. Dimensions: Panels shall be sized as shown on drawings.
 - D. Coating
 - Metal surfaces of NEMA 4X Stainless Steel outdoor panels and cabinets shall be prepared, primed and finish coated in accordance with the requirements of this specifications and coating manufacturer's recommendations. Scratches or blemishes in panel faces shall be filled prior to finishing. One coat of primer shall be applied at the manufacturer's recommended dry film thickness and allowed to dry prior to applying the first finish coat. Provide a quart of finish paint from batch used for final finish coat.
 - 2. Finish coat of NEMA 4X Stainless Steel outdoor panels and cabinets shall be an aliphatic air-dry polyurethane or epoxy panel enamel. Cabinet interiors shall be Fed. Std. color 27880, white. Exterior color of cabinets mounted indoors shall be Fed. Std. color 27880, white.
 - 3. Sub-panel of all panels and cabinets shall be painted Fed. Std. color 27880, white.
 - E. Face-Mounted Instrument Reinforcement: Face-mounted devices shall be mounted to panel doors using mounting methods recommended by the component manufacturer with mounting kit parts provided by the component manufacturer specifically for the component. If such a mounting method causes the door to deform or allows the component to sag so as not to be perpendicular to the door surface, then the CONTROL SYSTEM INTEGRATOR shall design and install appropriate reinforcement to prevent these conditions.
 - F. Miscellaneous
 - 1. Face-mounted equipment shall be flush or semi-flush, with flat black escutcheons. Cutouts for future equipment and holes resulted from removal of existing devices shall be blanked off with suitable covers as required to retain the cabinet's NEMA rating. Component identification shall be hot ink stamped on the panel interior.

- 2. All miscellaneous hardware and fittings shall be stainless steel. Stainless steel shall meet or exceed the corrosive-resistant properties of 316 stainless steel.
- 3. Install large folding shelf for test equipment or laptop. The large folding shelf material shall match the enclosure finish. The large folding shelf size shall be a minimum of 18.0" x 18.0".

2.03 NAMEPLATES

A. Machine engraved, three ply laminated phenolic nameplates shall be provided for all panels and cabinets as shown on the Contract Drawings. Nameplates shall be black with white lettering. Nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel sheet metal screws. The height of each character shall be a minimum of 3/16" except as noted.

2.04 WIRING AND ELECTRICAL DEVICES

- A. General: Provide the wiring and electrical devices specified below and install these and internal panel wiring as shown on the Contract Drawings. All spare PLC input/output points shall be wired to terminal blocks with interposing relays and surge protection.
- B. Power Distribution
 - 1. Unless otherwise specified, power for instrumentation equipment shall be obtained from a 120 volt, 60 hertz distribution panel-board in the Lighting Panel.
 - 2. Each cabinet shall be equipped with a 120 VAC main power disconnect circuit breaker and power distribution circuit breakers as shown on the Contract Drawings. The main power disconnect breaker shall be a one pole breaker rated at the amperage shown on the Contract Drawings. Distribution circuit breakers shall be single pole rated at the amperage shown on the Contract Drawings. The circuit breaker shall be rated at 250VAC maximum with a short circuit rating of 10,000 amps for all breaker ratings. The circuit breakers shall be mounted on a standard DIN rail, and shall be Allen-Bradley Channel Mounting Type, or equal.
 - 3. For each power distribution circuit breaker, a neutral return terminal block shall be installed at the bottom of the breaker rail. The neutral return terminal block shall be standard DIN rail mounted, and shall be rated to carry required amperes and accept up to two 12 AWG wires. This terminal block shall conform to the requirements specified herein.
 - 4. Each cabinet shall be provided with grounding type receptacle power outlets for 120 VAC power supply connections as shown. Each piece of equipment which is equipped with an ac power cord shall be plugged into a power outlet.
- C. Panel Connection Wire and Cable
 - 1. All cable furnished by the CONTROL SYSTEM INTEGRATOR, including cable with any and all wires terminated at both ends within the same panel or enclosure and cable with any wires terminated at more than one panel or enclosure, shall conform to the requirements specified below.
 - a. Power and Control Cable Power and control wiring shall be single conductor stranded copper NFPA 70 Type MTW. Power wiring from the main circuit breaker to distribution breakers shall be 12 AWG minimum. All other single conductor 120 VAC and 24 VDC power and common return wiring, common

ground buses and all common logic bus circuits shall be 16 AWG minimum. Circuits protected by 15 Amp circuit breakers shall be 14 AWG minimum. All power wiring shall be rated for 600V and 80°C.

- b. Single Conductor Wire All single conductors used for logic, RTU input/output and discrete control circuit wiring shall be No. 18 AWG stranded conductor copper, Belden Type 9918 (0.080-inch O.D.), or equal.
- c. Multi-conductor Foil-shield Cable (TP) All multi-conductor cable used for logic, RTU input/output and discrete control circuit wiring shall be No. 16 AWG stranded copper conductors with polyvinyl/chloride jacket. The cable shall be rated for a minimum of 600 volts and 80°C. The cable shall have an overall aluminum/polyester foil shield with drain wire, Alpha XTRA-Guard 1, or equal.
- d. Analog Signal Cable Wiring for 4-20 milliampere, 1-5 volt DC signals and other analog signals shall be No. 18 AWG stranded copper twisted pair shielded cable, 80°C rated, UL listed, 0.25 inches maximum outside diameter, with 100 percent coverage aluminum foil mylar-lines shield and No. 22 AWG (minimum) stranded tinned copper drain wire, Houston Wire and Cable, Belden, or equal. Multi-pair analog signal cable shall be individually shielded (with drain wire) No. 18 AWG stranded conductor copper with a 100 percent aluminum/polyester foil shield with drain wire and an outer PVC jacket. The cable is designated TSP on the Contract Drawings. The cable shall be rated for 600V, 80°C (NEC Article 300-3).
- e. Multi-Individual Conductor (TP) Multi-individual conductor cables used for logic, RTU input/output and discrete control circuit wiring shall be number 16 AWG stranded copper conductors with polyvinyl/chloride jacket. The cable shall be rated for a minimum of 600V and 80°C. The cable shall be Belden, or equal.
- f. Wire Tagging, all panel connection wiring shall be tagged at terminations with machine printed slip on type tags. The CONTROL SYSTEM INTEGRATOR shall show wire/cable tag designations on all wiring diagrams submitted to the OWNER. There shall be a tag placed within two inches of any wiring termination. The tag shall be fixed to the wire to prevent the tag from sliding more than two inches from the terminal as the result of gravity and vibration.
- 2. Power and Control Circuits
 - a. Control circuit, logic bus and power circuit wires shall be tagged as defined in this paragraph.
 - b. Control Circuits: Each individual connection wire shall be tagged at both ends of the wire with a wire number. The tag shall be placed on the wire within two inches of the terminal to which the wire is terminated. The CONTROL SYSTEM INTEGRATOR shall assign a unique number for each wire within a panel.
 - c. Power Circuits: All 120 VAC power wires shall be tagged with the designation "120 VAC-" followed by the circuit breaker number shown on the Contract Drawings, then followed by a letter designating whether the wire carries the line (L), neutral (N) or power ground (PG).
 - d. Positive 24 VDC power circuit and power bus wires shall be tagged with the designation "+24 VDC-" followed by the circuit breaker number shown on the Contract Drawings, and 24 VDC power returns shall be designated with "24 VDC COMMON".

3. Wire Colors: Control, logic bus and power conductors in panels shall have the following insulation colors:

Usage	Color
Line Power	Black
Neutral	White
Power Ground	Green
+24 VDC	Blue
24 VDC Common	White with Blue Stripe
DC Control	Blue
AC Control	Red
DC Status and Alarm	Blue
AC Status and Alarm	Red

- 4. Signal Circuits: Signal circuit multi-conductor cables shall be tagged at each end with the designation shown on the wiring diagram. Each signal conductor shall be tagged at each end with the designation of the terminal block to which it is connected. Individual conductors in each pair of twisted-pair cable shall have distinctly different colors, such as black and white, black and clear. Shield ground common wires connected between drain wire terminals shall be green and shall be tagged "SG".
- D. Terminal Blocks
 - 1. Unless otherwise shown or specified, terminal blocks shall be captive screw with pressure plate, DIN EN 50035 rail 600 volt rating. Terminal blocks for Input/Output shall be prewired type as specified in Section 17300. Terminal blocks shall be the type specified in the following table, or equal:

Description	Туре	Application
Terminal Block or equal	Phoenix UK 5 N	120 VAC, Neutral
Grounding Terminal	Phoenix USLKG 5	Equipment Grounding Block
End Clamps	Phoenix E/NS 35 N	Each Group of Blocks
Terminal Marking	Phoenix ZB 6	All terminal Blocks as required
Terminal Strip Marker	Phoenix KLM-A	Each Group of Blocks
Insertion Strip	Phoenix ESL	As Required

2. Provide Phoenix Contact UK6.3 fused disconnects with light indicators for 24VDC and 120VAC circuits with fuses as shown on the drawings (www.phoenixcon.com). Provide 20 fuses of each type as spares.

- E. Terminal Tags, Covers and Markers: Each terminal strip shall have a unique identifying alphanumeric code designation at one end and a plastic marking strip running the entire length with a unique number for each terminal. The CONTROL SYSTEM INTEGRATOR shall assign terminal strip numbers from the number "1" and continuing in ascending cardinal order. The terminal strip designation shall be the letters "TB" followed by the terminal strip number. The strip and terminal point designations shall be machine printed and I/8 inch high. Terminal blocks carrying 120 VAC power circuits shall be provided with a transparent, hinged cover for personnel protection and accessibility.
- F. Wire Routing: Wires shall be routed in slotted plastic wire-ways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts shown on the Contract Drawings to be for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Ducts shown for 24 VDC shall be used for all other wires and cables. Routing of 120 VAC in combined ducts shall be minimized. Wires and cable shall be routed along the shortest route between termination points, excepting routes which would result in routing 120 VDC and other wires and cables in the same duct. For intrinsically safe signal wiring refer to ANSI/ISA RP12.6 "Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations." Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable. Wires and cables shall be placed in the ducts in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together.
- G. Wire Terminations
 - 1. Single wire and cable conductors shall be terminated according to the requirements of the terminal device.
 - 2. For captive screw pressure plate and screw terminals, appropriately sized lugs shall be used. Lugs shall be crimp on type that forms gas tight connections. All crimping shall be done using a calibrated crimping tool made specifically for the lug type and size being crimped.
 - 3. On shielded cables, the drain wire shall be covered with insulating tubing along its full bare length between the cable jacket and the terminal lug or terminal pressure plate.
- H. Single Position Indicating Lights
 - 1. Single position indicating lights shall be 24 VDC, NEMA 13, heavy-duty, oil-tight, LED type, nominal 1.5 inch diameter. The lens color shall be as designated on drawings.
 - 2. Single position indicating lights shall be Micro-switch Type PT, Westinghouse Type PB2, General Electric Type CR104P, or equal.
- I. Electro-Mechanical Relays: Control relays shall be UL or CSA approved, and provided with two form C silver contacts rated at 3 amperes at 28 VDC, and shall be hermetically sealed. Where the Contract Drawings show a requirement for more than two contacts for a single control relay, two relays shall be provided with the coils wired in parallel. Coils shall be 24 VDC. Relays shall be mounted on sockets with retainers, and shall be wired with drop out voltage spike suppression diodes in parallel with all coils, with the cathode of the diode connected to the positive side of the coil. Electro-mechanical Control Relays shall be IDEC (www.idec.com) type RY2S-LD with indicator light, Potter and Brumfield (www.tycoelectronics), or equal.

- J. Cabinet Lighting: Each panel shall be provided with an internal fluorescent light. Lights shall operate from 120 VAC, and shall be wired to power through a door-mounted switch, which shall be activated by opening the cabinet door, to be located and wired as shown. Cabinet lights shall be Hoffman ALF16D18R, or equal.
- K. Power Line Surge Protectors: Each panel shall be provided with a 120 VAC, 20 Ampere service power line surge protector. The surge protectors shall be heavy duty, multi-stage, and high speed. Response time shall be 5 nanoseconds maximum, and shall allow 340 Volts maximum peak surges to pass through. Protector shall be wired to the cabinet ground bar via a dedicated #8 AWG solid copper wire. The power line surge protectors shall be EDCO Type HSP-121 (www.edcosurge.com), or equal.
- L. PLC I/O Wiring requirement: All PLC I/O logic circuit wiring inside the PLC panel shall conform to the requirements specified below:
 - 1. Discrete Input Wiring Requirement:
 - a. Each discrete input circuit shall have an interposing relay in line to prevent any over voltage surge coming across to the PLC I/O boards. Interposing relay shall be properly sized for each different input circuit. Provide a fuse per common group.
 - b. Each spare discrete input shall be furnished with an interposing relay hardwired to the terminal as well.
 - 2. Discrete Output Wiring Requirement:
 - a. No matter what type of PLC/RTU discrete output will be used in the systems, "dry" contact or semiconductor/transistor type output, every discrete output shall have an interposing relay for an isolation of PLC I/O board from the field side. The interposing relay shall be rated 24 VDC coil and 2 amp contact for 120 VAC or 24 VDC. If transistor type of discrete output board is selected and used for DC circuit, a drop out voltage spike suppression protection circuit shall be paralleled in each coil circuit. Provide a fuse per common group.
 - b. Each spare PLC/RTU output shall have an interposing relay hardwired to the terminal block.
- M. Analog Input and Output Wiring Requirement:
 - a. Each analog I/O shall have a voltage surge arrester in circuit to protect analog input from the any electronic surge damage. Phoenix Contact (www.phoenixcon.com) DIN mounted overvoltage arrester PLUGTRAB PT or TERMITRAB series shall be used in each analog circuit, including all spare I/O. Provide a fuse for each analog signal.
- N. Panel Ground
 - 1. Each panel shall be provided with a 1 inch high x 0.25 inch thick solid copper grounding bus bar across the bottom of the panel. The grounding bar shall be mounted on insulated standoffs so that no electrical connection is made between the grounding bar and the cabinet through the mounting. The ground bar shall be drilled and tapped for a .25-20 screws at .5 inch intervals along its entire length.
 - 2. An uninstalled solid copper #8 AWG ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panel. The ground connection to the enclosure and panel shall be made by sanding the paint finish off a small area, drilling a hole for a .25 inch bolt and mounting a .25-20 bolt to the panel to serve as a grounding stud. The grounding

stud shall be attached with a nut and flat washers on both sides of the enclosure/panel, and with an inside tooth star lock washer next to the panel surface. The star lock washer shall be on the inside surface of the enclosure, and the front surface of the mounting panel. The grounding wire shall be secured to the stud with a nut and inside tooth star lock washer. These grounding points shall be located within 12 inches of the bottom of the grounding bar.

- O. Power Supply: Each panel shall be provided with 24 VDC switching type power supplies connected in parallel via current steering diodes. These power supplies shall operate from 120 VDC input power and shall provide direct current output current of 10 Amperes at 24 VDC at 40°C, and shall be adjustable from 24 to 28 VDC by screw driver operated adjustment. Input power regulation shall be .2% from 105 to 130 VDC. Output load regulation shall be .2% maximum from zero to full load. Ripple shall not exceed .5% at full load. The power supplies shall have integral output current limiting and over voltage protection. The power supplies shall have fully enclosing cases. The power supply shall be manufactured by Acopian (www.acopian.com), or approved equal.
- P. Condensation Heater: Provide thermostatically operated condensation space heaters, which are sealed and safe to touch.
- Q. Wiring Duct: Plastic wiring duct shall be slotted type with dust cover, panduit type e or ne, as required.
- PART 3 EXECUTION
- 3.01 TEST REQUIREMENTS
 - A. The CONTROL SYSTEM INTEGRATOR shall shop test the panels and correct any defects discovered prior to delivery. These tests shall consist of the following:
 - 1. The CONTROL SYSTEM INTEGRATOR shall verify that each wiring connection is made properly by checking electrical continuity, assuring that connections have less than one Ohm resistance end to end, and that no cross continuity exists between separate circuits.
 - The CONTROL SYSTEM INTEGRATOR shall conduct a test of all power circuits and power supply equipment to verify that proper voltages are delivered and all power supply equipment is operating according to the manufacturer's specifications. These tests shall be witnessed by the OWNER's representative. The CONTROL SYSTEM INTEGRATOR shall certify the results in writing to the OWNER.
 - 3. The CONTROL SYSTEM INTEGRATOR shall functionally test each electrical device specified in Part 2 below to verify correct operation. The CONTROL SYSTEM INTEGRATOR shall also test each input/output point. Inputs shall be exercised at the location in the panel the greatest distance in the circuit from the PLC chassis and verified through to the PLC processor. Results shall be demonstrated on a programming terminal. Each output shall be exercised from a programming terminal and verified through to the panel location the greatest distance in the circuit from the PLC chassis. At a minimum, analog inputs and outputs shall be tested at 0%, 25%, 50%, 75%, and 100% of range. This test shall be witnessed by the OWNER's representative and the CONTROL SYSTEM INTEGRATOR shall certify the results in writing to the OWNER. Test the operator interface unit, including simulated alarm conditions.

4. The CONTROL SYSTEM INTEGRATOR shall test Ground Fault Interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

3.02 PANEL INSTALLATION

A. Shop Testing: The CONTROL SYSTEM INTEGRATOR shall coordinate panel delivery with the construction of the control room and panel locations to minimize field handling.

END OF SECTION

SECTION 17920

CONTROL NARRATIVE

PART 1 GENERAL

1.01 SCOPE OF WORKS

- A. This section describes work to be performed by the SCADA Programming Engineer. The Contractor is only responsible for items where noted.
- B. Configure, design, program and test the required process control logic that is defined in the provided Control Narrative.
- C. The developed programs and configuration shall meet the required operation and process control.
- D. All the developed programs, including PLC, OIU, existing SCADA programs and configuration shall be completely tested before the system field startup and commissioning.
- E. The following paragraphs are a general outline of the process control and operation.
- F. The Owner's SCADA Instrumentation Control Design Standards shall be followed in the PLC and existing SCADA configuration and programming. These documents are available upon request from the Owner.
- G. PLC programs shall be capable of functioning normally in the absence of OIU or existing SCADA without any special modifications. Process logic, including monitoring, control and alarming functions shall be programmed at the PLC level only.

Abbreviations used in this section:

ATS	Automatic Transfer Switch
A/M	Auto/Manual
DCS	Distributed Control System
GUI	Graphic User Interface
HMI	Human Machine Interface
HOA	Hand-Off-Auto
HOR	Hand-Off-Remote
LOR	Local-Off-Remote
L/R	Local/Remote
MCC	Motor Control Center
MCP	Master Control Panel
MMR	Motor Management Relay
OCA	Open-Close-Auto
OIU	Operator Interface Unit
OSC	Open-Stop-Close
PID	Proportional + Integral + Derivative
PLC	Programmable Logic Controller
PMU	Power Monitoring Unit
RVSS	Reduced Voltage Solid-State Starter

SCADA Supervisory Control and Data Acquisition

- S/S Start/Stop
- VCP Vendor Control Panel (Supplied by Equipment Vendor)
- VFD Variable Frequency Drive
- VSD Variable Speed Drive

1.02 SUBMITTALS

- A. Refer to Section 17000 Instrumentation Special Provisions.
- PART 2 REQUIREMENTS

2.01 GENERAL

- A. Shall coordinate with the SCADA Support Group to obtain the Owner's standard userdefined function blocks.
- B. PLC program shall use the Owner's preferred PLC programming language.
- C. Equipment tag name shall comply with the Owner's equipment identification naming convention. The Contractor shall coordinate with the Owner to obtain the equipment naming convention.
- D. The PLC Input/output list shall contain all items (Field, HMI, and Peer-to-Peer) to be configured for the point and shall be capable of being imported and exported into the system via an Excel spread sheet.
- E. The format of the Input/Output list shall follow the Owner SCADA I&C Standards. These documents are available upon request from the Owner.

2.02 PLC/SCADA CONTROL FUNCTIONS

- A. General: The SCADA shall display the status or value of all PLC input and output points and calculated points described in this section, detailed in the I/O schedule and shown on the P&ID drawings.
- B. Operator entered setpoints shall be constrained to match PLC programmed setpoint ranges. If a value lower than the setpoint range is entered, the PLC program shall default to the lowest possible range value. If a value higher than the setpoint range is entered, the PLC program shall default to the highest possible range value. PLC shall alert the operators of the valve being rejected.
- C. In general, confirmed PLC setpoint entries become the default program values. Should a PLC reboot occur, intended or uncontrolled event, the PLC program shall be automatically restored with last setpoint entries. No operator intervention shall be necessary to bring a freshly rebooted PLC online and operational.
- D. Fail Conditions: In addition to monitoring fail contacts for controlled equipment, if at any point a device fails to start, stop, open or close as commanded by the PLC, a timeout fail condition shall be generated by the PLC and displayed at the SCADA.
- E. Alarms related to SCADA displayed field equipment and facilities shall be displayed on the related system control screen as well as recorded in the historical alarm summary. Reference Specification Section 17520 for additional requirements.

- F. The entire system alarm history (read-only) shall be made accessible at the SCADA. Alarms shall be assigned to one of three (maximum) sub-groups. The alarm sub-groups shall be as defined at the conclusion of the project Graphics Meetings. An alarm configuration screen at the SCADA shall allow an authorized operator to enable or disable any SCADA alarm notification without the need to access the control system software configuration tools.
- G. Event Logging: An event log, separate from the alarm history, shall be made accessible at the SCADA (read-only). The event log shall date/time stamp and record any discrete change in status of the equipment monitored by the PLC (e.g. Local/Remote, Auto/Manual, Run/Off, Open/Close, Intrusion, Control Setpoint Change, Start Sequence Change, Alarm Enable/Disable, Out-of-Service status change, etc.). Events shall be assigned to one of four (maximum) sub-groups. The event sub-groups shall be as defined at the conclusion of the project Graphics Meetings.
- H. Loop tuning parameters: The SCADA interface shall be configured to allow operators with supervisory level security clearance, access to all loop tuning parameters from the SCADA for any control loop. Changing loop tuning parameters SHALL NOT require reconfiguring, reprogramming, or reloading of the PLC program. All changes to any loop tuning parameters shall be logged to the historical database event log.
- I. Equipment READY Logic: "Ready" shall be defined in the PLC program (if not already defined by field relay logic) as follows:
 - 1. Field equipment is currently in Remote and/or Auto mode (with LOS and/or disconnect switch disengaged).
 - 2. There are no fail conditions pending (including field E-Stop)
 - 3. The equipment is not currently in Run mode.
 - 4. No run inhibit conditions exist
- J. Ready shall be interpreted as "being available for remote (PLC and/or SCADA) operation". SCADA Manual mode cannot be achieved without the related equipment having a READY status. (Note: Once a run status is confirmed under this scenario, the equipment shall be noted to be running in Auto mode).
- K. Flow Signal Dampening: The PLC shall be programmed to dampen the incoming analog signal of all flow meters. This shall be accomplished by averaging the flow signal over a five second period. Specifically, the PLC shall sample the flow every half second for five seconds to calculate the average flow.
- L. Flow Totalization: The PLC shall be programmed to totalize flow volume. Volume shall be accumulated at a rate of once every five seconds. Flow totalization logic shall utilize dampened flow signals as described in paragraph H of this section.
- M. Runtime and Number of Starts: The PLC shall be programmed to calculate all motor runtimes and display the value in tenths of an hour on the SCADA. A lifetime runtime and a resettable/pre-settable runtime shall be provided for each distribution pump. The PLC shall be programmed to calculate the number of starts and display the value on the SCADA. A lifetime number of starts and a daily number of starts shall be provided for each distribution pump.

- N. Out of Service: The control system shall have the facility to assign an "Out-of-Service" tag to equipment monitored by the control system or to the entire pump station facility. During extended periods of maintenance and/or repair, an operator may make such an assignment so as to suppress associated alarms and inhibit OIU/PLC control functions.
- O. Control Strategy Refinement: It shall be understood that some refinement and/or minor modification of the control strategies shall be necessary over the course of the project at no additional cost. Forums for informal discussions and clarifications have been provided in these documents. They include the Presubmittal Conferences, Graphics/Reports Development meetings, Factory Testing, Field Development Phase and Startup. Note: All timer, level, position, analysis and flow rate values noted within the control strategies are provided for reference only and are subject to change based on final construction.

PART 3 EXECUTION

- 3.01 CONSTRUCTION SEQUENCE
 - A. Refer to specification 01015 Sequence of Construction for milestone completion requirements.
- 3.02 CONTROL NARRATIVES
 - A. Any of level transmitter fails, the PLC program shall automatically switch the other working level transmitter ready for level control and generate an alarm.
 - B. Provide PLC program to monitor each instrument reading and generate an alarm when instrument fails.
 - C. Well flush control
 - 1. Design Intent: Wetwell flush will be initiated by the Operator. During a Wetwell flush, the level in the wetwell will be lowered to induce a hydraulic jump that pushes settled debris down the length of the wetwell, to the last pumping unit. The pumping unit will continue to operate until it loses prime, removing the debris.
 - 2. Provide Wet Well Cleaning Cycle Start and Abort button on HMI screen
 - 3. Provide HMI selection button to allow operator to select pump to provide well flush control. Only one pump is allowed to provide this control.
 - 4. When Wet Well flush Start button is pressed, provide following control
 - a. Start the selected pump and keep pump running.
 - b. Energized pump low level lockout bypass relay to bypass pump low level lockout protection.
 - c. Monitor pump CT switch status. When CT switch is on, start a timer (default 1 min, 0-30 min adjustable).
 - d. When timer is up, stop the pump.
 - e. When Wet Well Cleaning Cycle abort button is pressed, stop the function. Pump shall be return to level control and clear pump well flush bypass output.
 - F. Initiate an alarm if pump fails during flush control.

- 3.03 Level control
 - A. Provide wet well level control
 - B. When pump HOA switch is selected at Hand position, pump shall be programmed to provide well level control
 - C. Provide HMI setpoint for lead/lag pump start and stop.
 - D. Provide pump runtime rotation control. The most least runtime pump shall be run first and the most runtime pump shall be stop first

END OF SECTION