SEABROOK

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS FOR WWTP UPGRADES – PHASE II (CLARIFIER REHAB AND LIFT STATION IMPROVEMENTS)

PROJECT NO. 1112-001-21

AUGUST 2017

STATE OF TEXAS
JOSE CARLOS SARACHO
123464
LICENSED
PROFESSIONAL ENGINEER

7-28-17

CobbFendley

TBPE Firm Registration No. 274 | TBPLS Firm Registration No. 100467

Construction Management ▪ Geographic Information Systems ▪ Hydraulics and Hydrology ▪ Land Development
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ADDENDUM NO. 1

WWTP Upgrades – Phase II - Seabrook, Texas

Date: August 18th, 2017

Engineer: Cobb, Fendley & Associates, Inc.
Carlos Saracho, P.E.
csaracho@cobbfendley.com
(713) 462-3242

Bidders are instructed to make the following changes to the Contract Documents and modifies the previous specifications, drawings and addenda, as noted below. Unaltered portions of the contract documents, specifications and drawings shall remain in effect. Acknowledgement of this Addendum in the space provided on the bid form must be done for the bidders bid package to be complete. Failure to do so may subject bidder to disqualification.

1. **Specifications**: Remove existing Table of Contents and Replace with **Revised Table of Contents**. Wage Scale for Engineering Construction was added.

2. **Specifications:** Add Sections;

   00811 Wage Scale for Engineering Construction
   CIQ Conflict of Interest Questionnaire
   03315 Concrete for Utility Construction
   09920 Protective Coatings
   Appendix G Approved Product List

END OF ADDENDUM

STATE OF TEXAS
JOSE CARLOS SARACHO
123464
LICENSED
PROFESSIONAL ENGINEER
08-18-2017

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Section 00020

NOTICE TO BIDDERS

Sealed BIDS for the construction of the **Wastewater Treatment Plant (WWTP) Improvements - Phase II, Seabrook Project No. 2017-303-1**, will be received until **10:00am Thursday, August 24th, 2017**, in the office of the Purchasing Coordinator, City Hall, 1700 First Street, Seabrook, Texas 77586. Bids must be received and time stamped by the Purchasing Coordinator prior to the aforementioned time, when they will be publicly opened and read aloud at the City Hall, City of Seabrook, 1700 First Street, Seabrook, Texas 77586. Bidding Documents may be obtained at www.civcastusa.com without charge. Documents can also be examined without charge at the office of the Purchasing Coordinator.

A Cashier's Check, Certified Check, or acceptable Bid Bond, payable to **City of Seabrook** in an amount not less than 5% of the maximum Bid price submitted, must accompany each Bid as a guarantee that, if awarded the Contract, the Bidder will within 15 calendar days of award of Contract enter into a Contract and execute Bonds on the forms provided in the Contract Documents.

The successful Bidder must furnish PERFORMANCE and PAYMENT BONDS on the forms furnished with the PROPOSAL, in the amount of 100% of the total Contract price.

A **non-mandatory** pre-bid conference will be held at City Hall, City of Seabrook, 1700 First Street, Seabrook, Texas 77586, on **Thursday, August 17th, 2017 at 10:00am**. All prospective Bidders are **encouraged** to attend.

Until final award of the Contract, the OWNER reserves the right to reject any or all Bids, to waive irregularities or technicalities, to re-advertise, or proceed to do the Work otherwise when in the best interests of the OWNER.

Section 00100

INSTRUCTIONS TO BIDDERS

The City may not accept this bid until it has received from the bidder a completed, signed, and notarized TEC Form 1295 complete with a certificate number assigned by the Texas Ethics Commission ("TEC"), pursuant to Texas Government Code § 2252.908 and the rules promulgated thereunder by the TEC. The undersigned understands that failure to provide said form complete with a certificate number assigned by the TEC will result in a non-conforming bid and will prohibit the City from considering this bid for acceptance.

Provision of Texas Ethics Commission Form 1295 ("TEC Form 1295") by Bidders: Effective January 1, 2016, pursuant to Texas Government Code § 2252.908 (the "Interested Party Disclosure Act" or the "Act"), the City may not award the contract to a bidder unless the bidder has provided to the City a completed, signed and notarized TEC Form 1295 which has been assigned a certificate number by the Texas Ethics Commission (the "TEC"). Pursuant to the rules prescribed by the TEC, the TEC Form 1295 must be completed online through the TEC's website, assigned a certificate number, printed, signed and notarized, and provided to the City. The TEC Form 1295 may accompany the bid or may be submitted separately, but must be provided to the City prior to the award of the contract. For purposes of completing the TEC Form 1295, the entity's name is City of Seabrook; the contract ID number is **1712-036-01** and the description of goods and services is, "**WWTP Improvements – Phase II**." Neither the City nor its consultants have the ability to verify the information included in a TEC Form 1295, and neither have an obligation nor undertake responsibility for advising any bidder with respect to the proper completion of the TEC Form 1295.

Refer to 00590 – Ethics Certification Form 1295 for completion.

1. DEFINITIONS

A. Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract (General Conditions) have the meanings assigned to them in the General Conditions. Other terms used in the Bidding Documents and not defined elsewhere have the following meanings, which are applicable to both the singular and plural thereof:

1. Bidder: One who submits a bid directly to the Owner.

2. Successful Bidder: The most qualified, responsible and responsive bidder to whom the Owner makes an award.

3. Bidding Documents: The Notice to Bidders, Instructions to Bidders, Supplementary Conditions to General Conditions, Special Conditions (Underground Utilities), Special Conditions to the Agreement, Proposal and the Proposed Contract Documents (including Addenda issued prior to receipt of Bids).

2. PREPARATION OF BIDS

A. Complete sets of bidding documents must be used in preparing bids. Neither the Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of bidding documents. Copies of bidding documents are made available only for the purpose of obtaining bids on the work and do not confer a license or grant for any other use.

3. QUALIFICATIONS OF BIDDERS

A. Each bidder must submit with the bid a Financial and Experience Statement. The statement shall be filed with the proposal in a separate sealed envelope marked "Financial and Experience Statement".

B. Financial statements from the three most qualified bidders will be retained by the Owner until award of the contract. NO FINANCIAL STATEMENT WILL BE READ ALOUD AT THE BID OPENING. Upon award of the contract, the statements of all unsuccessful bidders will be returned.

C. Additional written evidence of qualifications, such as financial data, previous experience, present commitments, and other such data as may be called for by the OWNER.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

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

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

C. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, underground facilities, and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions.

D. Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies, and obtain any additional information and data which pertain to the physical conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site or otherwise which

may affect cost, progress, performance, or furnishing of the Work, and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

E. On request in advance, OWNER will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall clean up and restore the site to its former condition upon completion of such explorations.

F. Failure to perform such investigations during the Bid period shall not relieve Bidder from responsibility for investigations, interpretations and proper use of available information in preparation of Bidder's proposal.

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

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

5. INTERPRETATION OF DOCUMENTS AND ADDENDA

A. All questions about the meaning or intent of the Contract Documents must be submitted to the Engineer in writing or through Civcast at least five (5) days prior to the opening of bids. Interpretations or clarifications considered necessary by ENGINEER in response to such questions will be issued by Addenda at least 48 hours prior to Bid Opening.

B. Any interpretation of the Contract Documents will be made only by Addendum duly issued, and a copy of such addendum will be made available to each prospective bidder recorded by ENGINEER as having received a set of Contract Documents. Each Bidder is responsible for obtaining Addenda. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

C. Addenda may also be issued to modify the Contract Documents as deemed advisable by OWNER and ENGINEER.

6. BID SECURITY

A. Each Bid shall be accompanied by Bid security made payable to OWNER in an amount of five percent of the Bidder's maximum Bid price and in the form of a bid bond, cashier's check, or certified check. Bid Bond shall have a "B+" rating from Best's Key Rating Guide, and shall be duly authorized by the State of Texas to execute Bid Security.

B. The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security with 15 calendar days after the Notice of Award, OWNER may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the earlier of the seventh day after the Effective Date of the Agreement or the forty-sixth day after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid security with Bids which are not competitive will be returned within 7 days after the Bid opening.

7. CONTRACT TIME

A. The number of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Time) are set forth in the Agreement.

8. LIQUIDATED DAMAGES

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

9. SUBSTITUTE OR "OR EQUAL" ITEMS

A. The Contract, if awarded, will be on the basis of materials and equipment described in the DRAWINGS or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, application for such acceptance will not be considered by ENGINEER until after the Effective Date of the Agreement. The procedure for submission of any such application by CONTRACTOR and consideration by ENGINEER is set forth in Paragraph 6.05 of the General Conditions and may be supplemented in the General Requirements (Division 1).

10. SUBCONTRACTORS, SUPPLIERS AND OTHERS

A. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, and other person and organizations (including those who are to furnish the principal items of material and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within 7 days after the Bid opening, submit to OWNER a

list of all such Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, person, or organization, either may, before the Notice of Award is given, request the apparent Successful Bidder to submit an acceptable substitute without an increase in Bid price.

B. If apparent Successful Bidder declines to make any such substitution, OWNER may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the Bid security of any Bidder. Any Subcontractor, Supplier, other person, or organization listed and to whom OWNER or ENGINEER does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06.B of the General Conditions.

C. In Contracts where the Contract Price is on the basis of Cost of Work Plus a Fee, the apparent Successful Bidder, prior to the Notice of Award, shall identify in writing to OWNER those portions of the Work that such Bidder proposes to subcontract and after the Notice of Award may only subcontract other portions of the Work with OWNER'S written consent.

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

11. BID FORMS

A. All Bids shall be completely filled out on the specified bid forms without modification or provisions unless otherwise required.

B. The Bids shall be completed in duplicate. The original shall be filed with the OWNER and the Bidder shall keep the duplicate.

C. The Bids must be clearly and legibly filled out in ink or typed.

D. All Bids must be officially executed. Bids by Corporations must be executed in the corporate name by the president or vice president (or other corporate officer, accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or assistant secretary. The corporate address and state of incorporation must be shown below the signature. Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature, and the official address of the partnership must be shown below the signature. All business entity names must be registered with the Secretary of State of Texas and appropriate office of registration.

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

12. SUBMISSION OF BIDS

A. Bids shall be submitted at the time and place indicated in the Notice to Bidders, and shall be enclosed in an opaque sealed envelope marked with the Project title, name and address of the Bidder and containing Bid security and other required documents. Bids will be securely kept unopened, until the specified time. The bids received after the specified time will not be considered. All incomplete Bids shall be considered non-responsive. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

13. MODIFICATION AND WITHDRAWAL OF BIDS

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

B. If, within 24 hours after Bids are opened, any Bidder files a duly signed, written notice with OWNER and promptly thereafter demonstrates to the reasonable satisfaction of OWNER that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided under the Contract Documents.

14. OPENING OF BIDS

A. Bids will be opened and read aloud publicly. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Bidders within 7 calendar days after the date of Bid opening.

15. BIDS TO REMAIN SUBJECT TO ACCEPTANCE

A. The apparent Successful Bid and the next two lowest Bids will remain subject to acceptance for 45 calendar days after the day of the Bid opening. All other Bids will be released and the Bid security returned within 7 days. OWNER may, in its sole discretion, release any Bid and return the Bid security prior to that date.

16. AWARD OF CONTRACT

A. Contract will be awarded on basis of best apparent value to the City. The base bid or the alternate bid may be used for award at the discretion of the City. The lowest base bid is not necessarily awarded the bid.

B. The Owner reserves the right to reject any and all bids, to waive any and all informalities not involving price, time or changes in the Work, to negotiate contract terms with the Successful Bidder, and to disregard all non-conforming, non-responsive, unbalanced or

conditional Bids. Also, OWNER reserves the right to reject the Bid of any Bidder if OWNER believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by OWNER. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

C. In evaluating Bids, OWNER will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

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

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

F. Alternate bid items are included in the Bid Form. The Successful Bidder will be determined based on either the low Base Bid (Part C of the Bid), or the low Base Bid Plus Alternate Bid (Part E of the Bid), at the discretion of the OWNER.

G. If the Contract is to be awarded, OWNER will give the Successful Bidder a Notice of Award within 60 calendar days after the day of the Bid opening.

17. CONTRACT SECURITY

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

18. INSURANCE CERTIFICATES

A. The CONTRACTOR shall provide and maintain a minimum coverage as defined in the Contract Documents (Article 5 of the General Conditions). The companies providing the coverage shall be acceptable to the OWNER (Certificate of Insurance Section 00650).

19. SIGNING OF AGREEMENT

A. When OWNER gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within 15 calendar days thereafter, CONTRACTOR shall sign and deliver the required number of counterparts of the Agreement, and attached documents to OWNER with the required Bonds. Within 10 calendar days thereafter, OWNER shall deliver one fully signed counterpart to CONTRACTOR. Each counterpart is to be accompanied by a complete set of the Drawings with appropriate identification.

20. PRE-BID CONFERENCE

A. A pre-bid conference will be held at the time and place indicated in the Invitation to Bid (Section 00020). Representatives of OWNER and ENGINEER will be present to discuss the Project. All prospective bidders are encouraged to attend and participate in the conference. ENGINEER will notify all prospective Bidders of record of any such Addenda as ENGINEER considers necessary in response to questions arising at the conference.

21. SALES TAX

A. Owner is exempt from Texas sales and use taxes pursuant to Texas Tax Code §151.309 as a political subdivision of the State of Texas. OWNER shall provide CONTRACTOR with a completed Texas Sales and Use Tax Exemption Certification as evidence of the applicability of such exemption and, accordingly, CONTRACTOR shall not collect Texas sales and use taxes from OWNER with respect to this Contract. CONTRACTOR and all Subcontractors to CONTRACTOR shall issue a Texas Sales and Use Tax Exemption Certification with respect to, and shall not pay Texas sales and use taxes on, all purchases of the following items that are exempt from Texas sales and use taxes pursuant to Texas Tax Code §151.311: (i) tangible personal property that will be incorporated into OWNER'S realty; (ii) tangible personal property that is necessary and essential for the performance of this Contract and is consumed entirely on the job site; and (iii) taxable services for use in the performance of this Contract that are performed at the job site and are either integral to the performance of this Contract or expressly required to be provided by this Contract. In addition, CONTRACTOR and all Subcontractors to CONTRACTOR (i) shall not include any provision for Texas sales and use taxes with respect to such exempt items in any bid or contract amount, and (ii) shall pass on to OWNER cost savings due to the exempt status of such exempt items. CONTRACTOR'S contracts with all Subcontractors to CONTRACTOR shall include the foregoing provision regarding the exemption from Texas sales and use taxes.

END OF SECTION

Section 00300

BID FORM

TO: City of Seabrook
City Hall
1700 First Street
Seabrook, Texas 77586

PROJECT: **WWTP Improvements – Phase II**

PROJECT NO.: 2017-303-1

BIDDER: R. P. Constructors, Inc.
(Print or Type full name of proprietorship, partnership, corporation, or joint venture.)

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

2. BIDDER accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the deposition of Bid Security. This Bid will remain subject to acceptance for 60 calendar days after the day of Bid opening. BIDDER will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within 15 calendar days after the date of OWNER'S Notice of Award.

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

   A. BIDDER has examined copies of all the Bidding Documents and of the following Addenda (receipt of all which is hereby acknowledged):

Date	Number
August 18, 2017	1

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

   C. BIDDER has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions as provided in Paragraph 4.02 of the General

Conditions, and accepts the determination of the technical data contained in such reports and drawings upon which BIDDER is entitled to rely.

D. BIDDER has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, and studies (in addition to or to supplement those referred to in C above) which pertain to the subsurface or physical conditions at the site or otherwise may affect the cost, progress, performance, or furnishing of the Work as BIDDER considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time, and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, or similar information or data are or will be required by BIDDER for such purposes.

E. BIDDER has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing underground facilities at or contiguous to the site and assumes responsibility for the accurate location of said underground facilities. No additional examinations, investigations, explorations, tests, reports, or similar information or data in respect to said underground facilities are or will be required by BIDDER in order to perform and furnish the Work at the Contract Price, within the Contract Time, and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.03 of the General Conditions.

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

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

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

4. BIDDER will complete the Work for the following price: (Note: Bid item is for work complete in place). These prices are to cover all expenses incurred in performing the work required under the Contract Documents, including related work that may not be specifically mentioned.

A. BID ITEMS

Item No.	Spec. No.	Item Description	Unit	Qty	Unit Price	Extended Price
BASE BID ITEMS						
SECTION 1 - SITE WORK						
1	01502	Mobilization (No Greater Than 5% of Total Bid)	LS	1	30,400.00	30,400.00
				SUBTOTAL SECTION 1	$30,400.00	
SECTION 2 - Clarifier Rehabilitation						
2	02221	Demolition and disposal of clarifier #2 including inspection and debris removal in drain line as shown on plan drawings	LS	1	20,000.00	20,000.00
3	11351	Clarifier #2 rehabilitation to include but not limited to cleaning, grout fill the clarifier floor to 1 in 12 slope at bottom of clarifier, furnish and install of existing electrical, mechanical and structural components (as shown on drawings), such as: Drive Mechanism, Center Column, Drive cage, Access bridge, Aluminum handrail and 4" toe plate (over the bridge), Skimmer Assembly, Skimmer Support, Algae brush mechanism, Scrapper arm, Spiral Scraper Blade (with adjustable Squeegee), RAS Booster Ring, Center Column, Influent Well, effluent trough, weir & baffle, as necessary for a working system.	LS	1	400,000.00	400,000.00
4	11351	Scum system including (but not limited to): The epoxy coated carbon steel pit (dimensions as noted in drawings), removable screen system, submersible pump, electrical control panel, local panel (HOA switch, and level control), valves and appurtenances, 2" SCH 80 PVC discharge scum Line (buried and exposed as shown on drawings) including, acrylic-based latex paint to all exposed pipe and pipefittings and pipe supports as necessary for a working system.	LS	1	70,000.00	70,000.00
				SUBTOTAL SECTION 2	$490,000.00	

SECTION 3 - SANITARY SEWER SYSTEM						
5	01506	Bypass pumping system, including but not limited to placement of temporary plug at closest manhole, provide power and alternative power source as needed to guarantee reliable pump system operation, furnish and install pumping system, temporary piping and piping support, manual screening at discharge point in the Bio-reactor, temporary fencing to secure bypass pumping equipment, traffic control measures for duration of bypass activities, cleaning sewer system (after finish bypass) of 400 feet (or closest manhole) in every direction around bypass manhole,	LS	1	40,000.00	40,000.00
6	02221	Demolition to include but not limited to: removal and disposal of pipe from submersible pump, to the first flange out of the ground, including supports, concrete slab (on top of buried portion of LS) , top slab of buried LS (first portion of existing lift station), removal of four 12" pipes in center wall, removal of existing grout on bottom slab, and pressure cleaning all surfaces	LS	1	20,000.00	20,000.00
7	15053	Lift station rehabilitation to include but not limited to cementious liner on existing concrete walls, construction of internal concrete walls, and top slab on LS, 3-ft X 4-ft H-20 rated access hatch, grout fill the floor to 1 in 12 slope to match opening, coat all internal structural surfaces as per SPECs Div 9, replace Ductile Iron Pipe in-kind, (total of 4 pump discharges), two 8-in diameter DIP Aeration Vents with three activated carbon air filters, pipe supports and braces to attach to the aeration basing wall to the height enough to access activated carbon filter from the walk way, including coating of pipes and all testing necessary for a working system	LS	1	110,000.00	110,000.00
				SUBTOTAL SECTION 3	$170,000.00	

B. SUPPLEMENTAL WORK BID ITEMS

** The items listed above are supplemental work items and are to be used only on the instructions of the field engineer on the job. No Compensation will be received for any part of these items unless they are actually used on the job under the direction of the field engineer. Any additional items required over and above those listed above will have to be secured on a change in contract and are not to be used until same has been approved by the City Auditor. The amount bid on the above listed items is to be included in the grand total of this contract.

C. TOTAL BID PRICE

Subtotal Section 1 – Site Work	$ 30,400.00
Subtotal Section 2 – Clarifier Rehabilitation	$ 490,000.00
Subtotal Section 3 – Sanitary Sewer System	$ 170,000.00
TOTAL BID PRICE	$ 690,400.00

D. DEDUCTIONS FROM BID ITEMS

BIDDER acknowledges that OWNER has a maximum funding limitation and that OWNER may adjust the total quantity of the items listed above to conform to that limitation. Reducing the quantity of items listed in this BID shall not invoke the provisions of Paragraph 11.03D.1 of the General Conditions unless such reduction exceeds 20% of any individual item.

5. BIDDER agrees that the Work will be substantially complete and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

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

   A. Required Bid Security in the form of a Bid Bond, Cashier's Check, or Certified Check.

7. Communications concerning this Bid shall be addressed to the business address of BIDDER indicated herein.

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

SUBMITTED on August 24, 20 17.

Bidder: R.P. Constructors, Inc.
(Print or Type full name of your proprietorship, partnership, corporation, or joint venture.*)

**By: _____ August 24, 2017
Signature Date

Name: Robert C. Pfeiffer President
(Print or Type name) Title

Address: 9455 IH 35 N, New Braunfels, Texas 78130
(Mailing)

_____
(Street, if different)

Telephone and Fax Number: 512-392-5111 512-392-5121 (Fax)
(Print or Type numbers)

* If Bid is a joint venture, add additional Bid Form signature sheets for each member of the joint venture.

** Bidder certifies that the only person or parties interested in this offer as principals are those named above. Bidder has not directly or indirectly entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding.

Note: This document constitutes a government record, as defined by § 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in § 37.10 of the Texas Penal Code.

END OF SECTION

Section 00500

AGREEMENT

THIS AGREEMENT is dated as of 9-19-17, by and between City of Seabrook (hereinafter called OWNER) and R. P. Constructors, Inc. (hereinafter called CONTRACTOR).

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

Article 1. WORK

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

"WWTP Improvements – Phase II"

Article 2. ENGINEER

The project has been designed by Cobb Fendley & Associates, who is hereinafter called ENGINEER and who is to act as OWNER'S representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIMES

3.1 The Work will be substantially completed within **300 calendar days** after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within **330 calendar days** after the date when the Contract Times commence to run.

3.2 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration preceding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER Five Hundred and no/100 dollars **($ 500.00)** for each day that expires after the time specified in paragraph 3.1 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the time specified in Paragraph 3.1 for completion and readiness for final payment or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER Five Hundred and no/100 dollars ($500.00) for each day that expires after the time specified in paragraph 3.1 for completion and readiness for final payment.

Article 4. CONTRACT PRICE

The OWNER shall pay to the CONTRACTOR in current funds the price or prices shown in CONTRACTOR'S Bid, which forms a part of this Contract, such payments to be subject to the General and Special Conditions of the Contract. The total amount awarded is $ 690,400.00 .

Article 5. PAYMENT PROCEDURES

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

5.1. Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR'S Applications for Payment as recommended by ENGINEER, on or about the last day of each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in Paragraph 2.07 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

5.1.1. Prior to Substantial Completion, progress payments will be made in an amount equal to 95% of Work completed, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions. Payment will not be made for materials on site but not construction in place.

5.1.2. Upon Substantial Completion, in an amount sufficient to increase total payments to CONTRACTOR to 95% of the Contract Price, less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.7 of the General Conditions.

5.2 Final Payment. Upon final completion and acceptance of the Work in accordance with paragraph 14.07 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraph 14.07.

Article 6. INTEREST

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the maximum rate allowed by law at the place of the Project.

Article 7. CONTRACTOR'S REPRESENTATIONS

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

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

7.2 CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions provided in paragraph 4.02 of the General Conditions, and accepts the determination of the technical data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.

7.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

7.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing underground facilities at or contiguous to the site and assumes responsibility for accurate location of said underground facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTS in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.03 of the General Conditions. .

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

7.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors, ambiguities or discrepancies that CONTRACTOR has discovered in the Contract and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

7.7 Under Section 231.006, Family code, the CONTRACTOR certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate.

Article 8. CONTRACT DOCUMENTS

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

8.1 This Agreement (Section 00500).

8.2 Performance and Payment Bonds

8.3 Notice of Award

8.4 General Conditions (Section 00700) and Supplementary Conditions (Section (0800)

8.5 Specifications bearing the title "*Construction Documents and Technical Specifications for "WWTP Improvements – Phase II*".

8.6 CONTRACTOR'S Bid (Section 00300).

8.7 Documentation submitted by CONTRACTOR prior to Notice of Award.

8.8 Certificate of Insurance.

8.9 Drawings bearing the general title ***"WWTP Improvements – Phase II".***

8.10 The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying or supplementing the Contract Documents pursuant to paragraphs 3.04 and 3.05 of the General Conditions.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 3.04 and 3.05 of the General Conditions.

Article 9. MISCELLANEOUS

9.1 Terms used in this Agreement, which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

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

any duty or responsibility under the Contract Documents.

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

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

This Agreement will be effective on_____, 20__ (which is the Effective Date of the Agreement).

OWNER

CITY OF SEABROOK

By: Thomas D. Kilgore

Attest: Pat Hicks

Address for giving notice:

1700 First Street

Seabrook, Texas 77586

THE CITY OF SEABROOK TEXAS

CONTRACTOR:

R. P. Constructors, Inc.

By: [signature]

Title: Robert C. Pfeifer, President

Attest: Dohn L. White

Dohn L. White, Secretary

Address for giving notice:

9455 IH 35 N

New Braunfels, Texas 78130

R.P. CONSTRUCTORS, INC. TEXAS

By: [signature]

Title: Treasurer

Attest: Lee Anne Smith

Agent for service of process:

Willis of Texas

920 Memorial City Way, Ste. 500

(If CONTRACTOR is a corporation or a partnership, attach evidence of authority to sign.) Houston, TX 77024

END OF SECTION

CONTRACTOR'S RESOLUTION ON AUTHORIZED REPRESENTATIVE

Robert C. Pfeiffer
Name or Names

I hereby certify that it was RESOLVED by a quorum of the directors of the

R.P. Constructors, Inc., meeting on the
Name of Corporation

06 day of November, 1991, that Robert C. Pfeiffer,

be, and hereby is authorized to act on behalf of R.P. Constructors, Inc.,
Name of Corporation

as its representative, in all business transactions conducted in the State of Texas, and; That all above resolution was unanimously ratified by the Board of Directors at said meeting and that the resolution has not been rescinded or amended and is now in full forces and effect; and;

In authentication of the adoption of this resolution, I subscribe my name and affix the seal of the corporation this 24 day of August, 2017.

Dohn L. White, Secretary

(seal)

Client#: 253 RPCON

ACORD™

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 9/21/2017

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Insurepointe of Texas, Inc.
2909 Hillcroft Ste #600
Houston, TX 77057
713 964-0022

CONTACT NAME: Carolyn Ruffeno x 134
PHONE (A/C, No, Ext): 713 964-0022 FAX (A/C, No): 713 964 0044
E-MAIL ADDRESS: cruffeno@insurepointe.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : BITCO General Insurance Corpora	20095
INSURER B : Commerce and Industry Insurance	19410
INSURER C : Texas Mutual Insurance Company	22945
INSURER D : Travelers Lloyds Insurance Comp	41262
INSURER E :	
INSURER F :	

INSURED
R. P. Constructors, Inc.
9455 IH 35 N
New Braunfels, TX 78130

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR X PD Ded:1,000 GEN'L AGGREGATE LIMIT APPLIES PER: POLICY X PRO-JECT LOC			CLP3648268	01/04/2017	01/04/2018	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG $	$1,000,000 $100,000 $5,000 $1,000,000 $2,000,000 $2,000,000 $
A	AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS / SCHEDULED AUTOS X HIRED AUTOS / X NON-OWNED AUTOS			CAP3648269	01/04/2017	01/04/2018	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident) $	$1,000,000 $ $ $ $
B	X UMBRELLA LIAB / X OCCUR EXCESS LIAB / CLAIMS-MADE DED X RETENTION $10000			BE039446236	01/04/2017	01/04/2018	EACH OCCURRENCE AGGREGATE $	$5,000,000 $5,000,000 $
C	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? Y/N Y (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N/A		TSF0001094038	01/04/2017	01/04/2018	X WC STATU-TORY LIMITS / OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $1,000,000 $1,000,000 $1,000,000
D	Rented/Leased Eqp			QT6604261B870TL	01/04/2017	01/04/2018	$700,000 Any One Item	
D	Builders Risk			QT6604261B87017	01/04/2017	01/04/2018	$20,000,000 Any One Loc	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Project: City of Seabrook - WWTP Improvements - Phase II
Certificate Holder Name Completed to Read: City of Seabrook, Contractor, Subcontractors, Engineer, Engineer's Consultants and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them ATIMA.
(See Attached Descriptions)

CERTIFICATE HOLDER

City of Seabrook
1700 First Street
Seabrook, TX 77586

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Susan M Palmer

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DESCRIPTIONS (Continued from Page 1)

The General Liability and Automobile policies include a blanket automatic additional insured endorsement that provides additional insured status to the certificate holder only when there is a written contract between the named insured and the certificate holder that requires such status. The General Liability, Workers Compensation and Automobile policies include a blanket automatic waiver of subrogation endorsement that provides this feature only when there is a written contract between the named insured and the certificate holder that requires it. The General Liability, Automobile & Workers Compensation policies include a specific notice of cancellation endorsement, providing for 30 days advance notice if the policy is cancelled by the company other than for nonpayment of premium, 10 days notice after the policy is cancelled for nonpayment of premium. The endorsement does not provide for notice of cancellation if the named insured requests cancellation. The General Liability policy includes an endorsement that contains primary and non-contributory wording. The Umbrella Liability is follow form over the Primary.

Section 00610

PERFORMANCE BOND Bond No. 58S210578

KNOW ALL MEN BY THESE PRESENTS: That R. P. Constructors, Inc. of the City of New Braunfels of Comal County, and State of Texas as principal, and Liberty Mutual Insurance Company, authorized under the laws of the State of Texas to act as surety on Bonds for principals, are held and firmly bound unto City of Seabrook (Owner), in the penal sum of $ 690,400.00 for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the 19th day of Sept. 20 17, for Work associated with the project named:

"WWTP Improvements – Phase II"

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if the said Principal shall faithfully perform said Contract and shall in all respects duly and faithfully observe and perform all and singular the covenants, conditions and agreements in and by said Contract agreed and covenanted by the Principal to be observed and performed, and according to the true intent and meaning of said Contract and Plans and Specifications hereto annexed, then this obligation shall be void; otherwise to remain in full force and effect;

"PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code, as amended, and all liabilities on this Bond shall be determined in accordance with the provisions of said Statute to the same extent as if it were copied at length herein."

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to the work performed thereunder, or the Plans, Specifications, or Drawings accompanying the same, shall in any way 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 to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this 5 day of October, 2017.

Contractor	**Surety**
R. P. Constructors, Inc.	Liberty Mutual Insurance Company
By:	By:
Title: Robert C. Pfeiffer, President	Title: Jo Ann Parker, Attorney-In-Fact
Address: 9455 IH 35 N	Address: 175 Berkeley Street
New Braunfels, Texas 78130	Boston, MA 02116
Telephone: 512-392-5111	Telephone: 617-357-9500
Fax: 512-392-5121	Fax: 617-350-9922

NOTICE: THE ADDRESS OF THE SURETY COMPANY TO WHICH ANY NOTICE OF CLAIM SHOULD BE SENT MAY BE OBTAINED FROM THE TEXAS DEPARTMENT OF INSURANCE BY CALLING ITS TOLL-FREE TELEPHONE NUMBER; 1-800-252-3439.

END OF SECTION

Section 00620

PAYMENT BOND Bond No. 58S210578

KNOW ALL MEN BY THESE PRESENTS: That R. P. Constructors, Inc. of the City of New Braunfels of Comal County, and State of Texas as principal, and Liberty Mutual Insurance Company, authorized under the laws of the State of Texas to act as surety on Bonds for principals, are held and firmly bound unto City of Seabrook (Owner), in the penal sum of $ 690,400.00 for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the 11th day of Sept. 2017, for Work associated with the project named:

"WWTP Improvements – Phase II"

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the Work provided for in said contract, then, this obligation shall be void; otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code, as amended, and all liabilities on this Bond shall be determined in accordance with the provisions of said Statute to the same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract, or to the Work performed thereunder, or the Plans, Specifications or Drawings accompanying the same, shall in any way 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 to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this 5 day of October, 2017.

Contractor	**Surety**
R. P. Constructors, Inc.	Liberty Mutual Insurance Company
By:	By:
Title: Robert C. Pfeiffer, President	Title: Jo Ann Parker, Attorney-In-Fact
Address: 9455 IH 35 N	Address: 175 Berkeley Street
New Braunfels, Texas 78130	Boston, MA 02116
Telephone: 512-392-5111	Telephone: 617-357-9500
Fax: 512-392-5121	Fax: 617-350-9922

NOTICE: THE ADDRESS OF THE SURETY COMPANY TO WHICH ANY NOTICE OF CLAIM SHOULD BE SENT MAY BE OBTAINED FROM THE TEXAS DEPARTMENT OF INSURANCE BY CALLING ITS TOLL-FREE TELEPHONE NUMBER; 1-800-252-3439.

END OF SECTION

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON RED BACKGROUND.
This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Certificate No. 7847443

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company West American Insurance Company

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, David Stephen Wightman; Denise Raker; Jo Ann Parker; Sylvia Hinojosa

all of the city of Houston, state of TX each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 28th day of July, 2017.

THE OHIO CASUALTY INSURANCE COMPANY INCORPORATED 1919 NEW HAMPSHIRE
LIBERTY MUTUAL INSURANCE COMPANY INCORPORATED 1912 MASSACHUSETTS
WEST AMERICAN INSURANCE COMPANY INCORPORATED 1991 INDIANA

The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
West American Insurance Company

By: David M. Carey
David M. Carey, Assistant Secretary

STATE OF PENNSYLVANIA ss
COUNTY OF MONTGOMERY

On this 28th day of July, 2017, before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at King of Prussia, Pennsylvania, on the day and year first above written.

TERESA PASTELLA COMMONWEALTH OF PENNSYLVANIA NOTARY PUBLIC

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Teresa Pastella, Notary Public
Upper Merion Twp., Montgomery County
My Commission Expires March 28, 2021
Member, Pennsylvania Association of Notaries

By: Teresa Pastella
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS – Section 12. Power of Attorney. Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts – SECTION 5. Surety Bonds and Undertakings. Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this _____ day of _____, 20 17.

THE OHIO CASUALTY INSURANCE COMPANY INCORPORATED 1919 NEW HAMPSHIRE
LIBERTY MUTUAL INSURANCE COMPANY INCORPORATED 1912 MASSACHUSETTS
WEST AMERICAN INSURANCE COMPANY INCORPORATED 1991 INDIANA

By: Renee Llewellyn
Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00 am and 4:30 pm EST on any business day.

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Liberty Mutual.
SURETY

TEXAS
IMPORTANT NOTICE

To obtain information or make a complaint:

You may call toll-free for information or to make a complaint at
1-877-751-2640

You may also write to:

2200 Renaissance Blvd., Ste. 400
King of Prussia, PA 19406-2755

You may contact the Texas Department of Insurance to obtain information on companies, coverages, rights or complaints at
1-800-252-3439

You may write the Texas Department of Insurance
Consumer Protection (111-1A)
P. O. Box 149091
Austin, TX 78714-9091
FAX: (512) 490-1007
Web: http://www.tdi.texas.gov
E-mail: ConsumerProtection@tdi.texas.gov

PREMIUM OR CLAIM DISPUTES:

Should you have a dispute concerning your premium or about a claim you should first contact the agent or call 1-800-843-6446. If the dispute is not resolved, you may contact the Texas Department of Insurance.

ATTACH THIS NOTICE TO YOUR POLICY:

This notice is for information only and does not become a part or condition of the attached document.

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Para obtener informacion o para someter una queja:

Usted puede llamar al numero de telefono gratis para informacion o para someter una queja al
1-877-751-2640

Usted tambien puede escribir a:

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King of Prussia, PA 19406-2755

Puede comunicarse con el Departamento de Seguros de Texas para obtener informacion acerca de companias, coberturas, derechos o quejas al
1-800-252-3439

Puede escribir al Departamento de Seguros
de Texas Consumer Protection (111-1A)
P. O. Box 149091
Austin, TX 78714-9091
FAX # (512) 490-1007
Web: http://www.tdi.texas.gov
E-mail: ConsumerProtection@tdi.texas.gov

DISPUTAS SOBRE PRIMAS O RECLAMOS:

Si tiena una disputa concerniente a su prima o a un reclamo, debe comunicarse con el agente o primero. Si no se resuelve la disputa, puede entonces comunicarse con el departamento (TDI)

UNA ESTE AVISO A SU POLIZA:

Este aviso es solo para proposito de informacion y no se convierte en parte o condicion del documento adjunto.

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

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Endorsed by

CONSTRUCTION SPECIFICATIONS INSTITUTE

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

21. *General Requirements*—Sections of Division 1 of the Specifications.

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

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

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

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

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

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

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

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

30. *PCBs*—Polychlorinated biphenyls.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

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

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

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

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

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

51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

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addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

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

C. *Day:*

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

D. *Defective:*

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

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

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

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

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

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

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

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

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

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

2.02 *Copies of Documents*

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

2.03 *Commencement of Contract Times; Notice to Proceed*

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

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2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

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

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

2. a preliminary Schedule of Submittals; and

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

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

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

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

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

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of

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the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

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

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

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

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

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

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

3.02 *Reference Standards*

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

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

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

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

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

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

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

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

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

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

3.04 *Amending and Supplementing Contract Documents*

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

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

1. A Field Order;

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

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3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

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

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

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

3.06 *Electronic Data*

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

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

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

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

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the

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Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

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

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

4.02 *Subsurface and Physical Conditions*

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

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

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

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

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

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

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

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

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

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

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

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

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

C. *Possible Price and Times Adjustments:*

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

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

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

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

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

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

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

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other

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professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

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

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

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

   a. reviewing and checking all such information and data;

   b. locating all Underground Facilities shown or indicated in the Contract Documents;

   c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

   d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

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

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

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or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

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

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

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

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

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

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

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

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by

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Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

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

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

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

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

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

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

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

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

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

5.02 *Licensed Sureties and Insurers*

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

5.03 *Certificates of Insurance*

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

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

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

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

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

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

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

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

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

   b. by any other person for any other reason;

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

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

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

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

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

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

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

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

6. include completed operations coverage:

   a. Such insurance shall remain in effect for two years after final payment.

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

5.05 *Owner's Liability Insurance*

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

5.06 *Property Insurance*

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

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

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

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

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

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

6. include testing and startup; and

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

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

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

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property

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insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

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

5.07 *Waiver of Rights*

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

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

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

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

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery

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against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

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

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

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

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

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ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

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

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

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

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

6.03 *Services, Materials, and Equipment*

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

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

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

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6.04 *Progress Schedule*

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

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

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

6.05 *Substitutes and "Or-Equals"*

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

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

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

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

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

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

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

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

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

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2. *Substitute Items:*

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

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

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

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

      1) shall certify that the proposed substitute item will:

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

         b) be similar in substance to that specified, and

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

      2) will state:

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

         b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

         c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

      3) will identify:

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

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

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

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

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

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

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

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

6.06 *Concerning Subcontractors, Suppliers, and Others*

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

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or

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other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

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

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

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

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

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

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

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

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6.07 *Patent Fees and Royalties*

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

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

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

6.08 *Permits*

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

6.09 *Laws and Regulations*

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

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all

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court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

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

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

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

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

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

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

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor

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shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

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

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

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

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

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

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D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

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

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

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

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1. *Shop Drawings:*

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

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

2. *Samples:*

   a. Submit number of Samples specified in the Specifications.

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

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

C. *Submittal Procedures:*

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

   a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

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

   c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

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

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

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop

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Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

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

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

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

E. *Resubmittal Procedures:*

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

6.18 *Continuing the Work*

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

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

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

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

2. normal wear and tear under normal usage.

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

1. observations by Engineer;

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

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

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

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

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

7. any correction of defective Work by Owner.

6.20 *Indemnification*

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

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

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Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

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

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

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

6.21 *Delegation of Professional Design Services*

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

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

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

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

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

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ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

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

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

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

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

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

7.02 *Coordination*

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

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

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

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

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

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7.03 *Legal Relationships*

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

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

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

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *Pay When Due*

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

8.05 *Lands and Easements; Reports and Tests*

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

8.06 *Insurance*

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

8.07 *Change Orders*

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

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8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

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

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and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

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

9.03 *Project Representative*

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

9.04 *Authorized Variations in Work*

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

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

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

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

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

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

9.07 *Determinations for Unit Price Work*

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

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

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

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

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

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

9.09 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

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

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

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

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

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

10.02 *Unauthorized Changes in the Work*

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

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10.03 *Execution of Change Orders*

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

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

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

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

10.04 *Notification to Surety*

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

10.05 *Claims*

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

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

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opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

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

1. deny the Claim in whole or in part;

2. approve the Claim; or

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

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

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

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

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

11.01 *Cost of the Work*

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

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

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Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

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

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

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

5. Supplemental costs including the following:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

11.02 *Allowances*

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

B. *Cash Allowances:*

1. Contractor agrees that:

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

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

C. *Contingency Allowance:*

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

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

11.03 *Unit Price Work*

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

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

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

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

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

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

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

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

12.01 *Change of Contract Price*

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

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

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

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

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

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

1. a mutually acceptable fixed fee; or

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

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

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

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

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

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

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

12.02 *Change of Contract Times*

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

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

12.03 *Delays*

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

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

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the

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control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

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

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

13.01 *Notice of Defects*

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

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

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

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

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

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

3. as otherwise specifically provided in the Contract Documents.

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

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

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

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

13.04 *Uncovering Work*

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

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

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

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

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13.05 *Owner May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

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

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

13.07 *Correction Period*

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

1. repair such defective land or areas; or

2. correct such defective Work; or

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

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

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

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

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

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

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

13.08 *Acceptance of Defective Work*

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

13.09 *Owner May Correct Defective Work*

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

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and

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equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

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

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

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

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

14.02 *Progress Payments*

A. *Applications for Payments:*

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

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the

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Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

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

B. *Review of Applications:*

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

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

   a. the Work has progressed to the point indicated;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

C. *Payment Becomes Due:*

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

D. *Reduction in Payment:*

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

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

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

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

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

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

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

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

14.04 *Substantial Completion*

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

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

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

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities

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

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

14.05 *Partial Utilization*

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

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

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

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

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

14.06 *Final Inspection*

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

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14.07 *Final Payment*

A. *Application for Payment:*

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

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

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

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

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

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

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

B. *Engineer's Review of Application and Acceptance:*

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

C. *Payment Becomes Due:*

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

14.08 *Final Completion Delayed*

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

14.09 *Waiver of Claims*

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

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

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

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

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

15.02 *Owner May Terminate for Cause*

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

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

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

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

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

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

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

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

3. complete the Work as Owner may deem expedient.

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

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

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

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

15.03 *Owner May Terminate For Convenience*

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

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

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

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

4. reasonable expenses directly attributable to termination.

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

15.04 *Contractor May Stop Work or Terminate*

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

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

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ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

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

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

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

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

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

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

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

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

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

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

17.02 *Computation of Times*

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

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17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

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Section 00800

SUPPLEMENTARY CONDITIONS

PART 1 – AMENDMENTS TO GENERAL CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (Section 00700 – General Conditions) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.01.B Delete Paragraph 2.01.B of the General Conditions in its entirety and insert the following in its place:

"When delivering executed contracts for the OWNER's signature, CONTRACTOR shall deliver to OWNER, with a copy to the ENGINEER, certificates and other evidence of insurance requested by OWNER which CONTRACTOR is required to purchase and maintain in accordance with Article 5."

SC-2.02 Amend the first sentence of Paragraph 2.02 of the General Conditions to read as follows:

"OWNER shall furnish to CONTRACTOR up to five printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction."

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

SC-4.02 Add the following new paragraphs immediately after Paragraph 4.02.B:

C. In the preparation of Drawings and Specifications, ENGINEER or ENGINEER's Consultants relied upon the following reports of explorations and tests of subsurface conditions at the Site:

1. Report No. 1140226101 prepared by Geotest Engineering, Inc. Houston, Texas, entitled: "Geotechnical Investigation Todville Sanitary Sewer Line Project, City of Seabrook, Texas"

SC-4.06G Delete Paragraph 4.06.G of the General Conditions in its entirety.

ARTICLE 5 – BONDS AND INSURANCE

SC-5.03.B Delete Paragraph 5.03.B in its entirety.

SC-5.04 Add the following new paragraph immediately after Paragraph 5.04.B:

C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 5.04.A.1 and A.2 of the General Conditions:

   a. State: Statutory
   b. Applicable Federal (e.g., Longshoreman's): Statutory
   c. Employer's Liability:
      $1,000,000 Each Accident
      $1,000,000 Disease – Policy Limit
      $1,000,000 Disease – Each Employee

2. Contactor's General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Contractor:

   a. General Aggregate: $2,000,000
   b. Products – Completed Operations Aggregate: $2,000,000
   c. Personal and Advertising Injury: $1,000,000
   d. Each Occurrence (Bodily Injury and Property Damage): $1,000,000
   e. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.
   f. Excess or Umbrella Liability
      1. General Aggregate: $2,000,000
      2. Each Occurrence: $1,000,000

3. Automobile Liability (including owned, hired, and non-owned vehicles) under Paragraph 5.04.A.6 of the General Conditions:

   a. Bodily Injury:
      Each person: $1,000,000
      Each accident: $1,000,000
   b. Property Damage:
      Each accident: $1,000,000

4. The Contractual Liability coverage required by Paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

   c. Bodily Injury:
      Each accident: $1,000,000
      Annual aggregate: $2,000,000
   d. Property Damage:
      Each accident: $1,000,000
      Annual aggregate: $2,000,000

SC-5.06.A Delete Paragraph 5.06.A in its entirety and insert the following in its place:

A. CONTRACTOR shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. This insurance shall:

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

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

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

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

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

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with

30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. CONTRACTOR shall be responsible for any deductible or self-insured retention.

C. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this Paragraph SC-5.06 shall comply with the requirements of Paragraph 5.06.C of the General Conditions.

SC-5.06 Delete Paragraphs 5.06.B, 5.06.D, and 5.06.E in their entirety.

SC-5.07.A Delete Paragraph 5.07.A in its entirety and insert the following in its place:

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. To the extent that Contractor's insurance conforms to the requirements of the Contract, Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused.

SC-5.07.B Delete Paragraph 5.07.B in its entirety.

SC-5.08 Delete Paragraphs 5.08.A and 5.08.B in their entirety.

SC-5.09 Delete Paragraph 5.09.A in its entirety and replace with the following:

A. If Owner has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by Contractor in accordance with Article 5 on the basis of non-conformance with the Contract Documents, Owner shall so notify Contractor in writing. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. Contractor shall purchase or maintain all of the bonds and insurance

required by the Contract Documents. Without prejudice to any other right or remedy, the Owner may elect to obtain equivalent bonds or insurance to protect Owner's interests at the expense of the Contractor, and a Change Order shall be issued to adjust the Contract Price accordingly.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

SC-6.07.B Delete Paragraph 6.07.B of the General Conditions in its entirety.

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

SC-11.03.C Delete Paragraph 11.03.D in its entirety and insert the following in its place:

D. The unit price of an item of Unit Price Work shall be subject to reevaluation and adjustment under the following conditions:

1. if the total cost of a particular item of Unit Price Work amounts to 5% or more of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by the Contractor differs by more than 25% from the estimated quantity of such item indicated in the Agreement; and

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

3. if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof; or if OWNER believes that the quantity variation entitles OWNER to an adjustment in the unit price, either OWNER or CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 10 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed.

END OF SECTION

Section 00811

WAGE SCALE FOR ENGINEERING CONSTRUCTION

1.01 In accordance with the Prevailing Wage law on Public Works (Article 2258 of the Texas Government Code), the public body awarding the contract does hereby specify the rates shown in Table 00811-A following to be the general prevailing rates in the locality in which the work is being performed.

1.02 This prevailing wage rate does not prohibit the payment of more than the rates stated.

1.03 The wage scale for engineering construction is to be applied to all site work greater than five (5) feet from an exterior wall of new building under construction or from an exterior wall of an existing building.

END OF SECTION

General Decision Number: TX170042 04/21/2017 TX42

Superseded General Decision Number: TX20160042

State: Texas

Construction Type: Heavy

County: Harris County in Texas.

HEAVY CONSTRUCTION PROJECTS Including Water and Sewer Lines (Does Not Include Flood Control).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017
1	04/21/2017

* SFTX0669-001 04/01/2017

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 29.03	15.84

SUTX2005-019 08/16/2005

	Rates	Fringes
CARPENTER	$ 14.04	0.00
CEMENT MASON/CONCRETE FINISHER	$ 12.50	1.17
ELECTRICIAN	$ 17.00	0.04
Formbuilder/Formsetter	$ 13.84	1.17
IRONWORKER, REINFORCING	$ 11.28	0.00
Laborers:		
Common	$ 8.94	0.00
Landscape	$ 7.35	0.00
Mason Tender Cement	$ 9.94	0.00
Pipelayer	$ 10.14	0.00

PIPEFITTER.....$ 17.00 0.04

POWER EQUIPMENT OPERATOR:
Backhoe.....$ 13.47 0.00
Bulldozer.....$ 12.58 0.00
Crane.....$ 15.33 0.57
Excavator.....$ 16.37 0.00
Front End Loader.....$ 12.16 0.00
Grader.....$ 12.20 1.48
Tractor.....$ 15.00 0.00

TRUCK DRIVER.....$ 12.02 1.02

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

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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 Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. 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.

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END OF GENERAL DECISION

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

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).

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. *See* 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.

OFFICE USE ONLY

Date Received

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 requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

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 officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.**

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ 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 of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

Signature of vendor doing business with the governmental entity

Date

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor or other person doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 1491, 80th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code by a person who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the person meets requirements under Section 176.006(a).

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 person becomes aware of facts that require the statement to be filed. *See* Section 176.006, Local Government Code.

A person commits an offense if the person knowingly violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.

OFFICE USE ONLY

Date Received

1 **Name of person who has a business relationship with local governmental entity.**

R.P. CONSTRUCTORS, INC. / ROBERT C. PFEIFFER

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.**

(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3 **Name of local government officer with whom filer has employment or business relationship.**

N / A

Name of Officer

This section (item 3 including subparts A, B, C & D) must be completed for each officer with whom the filer has an employment or other business relationship as defined by Section 176.001(1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire?

☐ Yes ☒ No

B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer named in this section AND the taxable income is not received from the local governmental entity?

☐ Yes ☒ No

C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?

☐ Yes ☒ No

D. Describe each employment or business relationship with the local government officer named in this section.

4

Signature of person doing business with the governmental entity

September 20, 2017

Date

Adopted 06/29/2007

House Bill 89 VERIFICATION

I hereby affirm that I am an authorized agent of R.P. Constructors, Inc. hereafter referred to as company, **do hereby affirm that the company named-above, under the provisions of Subtitle F, Title 10, Government Code Chapter 2270:**

1. **Does not boycott Israel currently; and**
2. **Will not boycott Israel during the term of the contract/agreement if awarded under this Request for Proposal.**

Pursuant to Section 2270.001, Texas Government Code:

1. *"Boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes; and*
2. *"Company" means a for-profit sole proprietorship, organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or any limited liability company, including a wholly owned subsidiary, majority-owned subsidiary, parent company or affiliate of those entities or business associations that exist to make a profit.*

09/20/2017
DATE

Robert C. Pfeiffer, President
SIGNATURE OF COMPANY REPRESENTATIVE

Section 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section describes the project in general and provides an overview of the extent of the work to be performed by the CONTRACTOR. Detailed requirements and extent of work is stated in the applicable Specification sections and shown on the Plans. CONTRACTOR shall, except as otherwise specifically stated herein or in any applicable part of these Contract Documents, provide and pay for all labor, materials, equipment, tools, construction equipment, and other facilities and services necessary for proper execution, testing, and completion of the work.

B. Any part or item of the work which is reasonably implied or normally required to make each installation satisfactorily operable shall be performed by the CONTRACTOR and the expense thereof shall be included in the applicable unit prices or lump sum prices bid for the work. It is the intent of these Specifications to provide the OWNER with the complete operable systems, subsystems, and other items of work. All miscellaneous appurtenances and other items of work that are incidental to meeting the intent of these Specifications shall be considered as having been included in the applicable unit prices or lump sum prices bid for the work even though these appurtenances and items may not be specifically called for in the Specifications.

1.02 DESCRIPTION OF THE PROJECT

A. The Work in this project includes the following:

1. Contractor shall coordinate draining and cleanup of Clarifier #2. During this time, Contractor shall take all necessary dimensions and measurements for the proposed clarifier mechanisms, as well as inspect the feed line (from Aeration basin to clarifier). Clarifier #2 shall be offline for as little time as possible during this work. Contractor is to re-establish flow after this work is complete until a second drain and cleanup is deemed necessary by coordination of fabrication of proposed mechanisms and demolition of existing clarifier mechanisms. Contractor to Demolish and coordinate disposal of mechanical components of Clarifier # 2. Contractor to furnish, install and test all components including, materials, equipment and appurtenances required to replace the existing mechanism, including but not limited to, one (1) center feed/peripheral overflow type clarifier suitable for installation in an existing concrete tank 67'-10" diameter approx., center assembly with drive unit, center column, influent feedwell, center cage, scraper arms, RAS Booster Ring, access bridge with operating platform, scum collection system, algae brush cleaners (ABCs) and anchor bolts. After inspection of the existing effluent trough, weir & baffle can be re-used and components replaced as needed to accommodate the new equipment with no additional cost. Contractor to re-grout bottom slope

to 1:12. The mechanism shall be a center-column supported, center feed, peripheral overflow type with a center drive mechanism rotating a suspended cage with two (2) sludge scraper arms attached. The contractor shall verify all tank dimensions.

2. The Scum collection system as part of this project shall include the scum pit as per dimensions specified in drawings, manual retrievable screen basket and pump system including NEMA 4X control panel with control system to operate the pump. The scum system shall include field routing and coordination with existing underground utilities to run the buried potion of 2" SCH 80 pipe with 2 ft minimum cover, and supports for the above ground portion at a maximum free spacing of 4ft. All exposed pipe shall be coated with a light colored acrylic or latex paint that is chemically compatible with the PVC/CPVC products proposed. Compatibility information shall be confirmed with the paint manufacturer. The colors shall be selected from the manufacturer's standard color chart by the Owner. The use of oil based paints is not allowed. Contractor to provide "clean-out" with screwed end (flush to ground when buried) after every accumulative 90 degree turn. Contractor to install thermal expansion joints on exposed pipe as per manufacturer's recommendations.

3. The Lift Station will require demolition and replacement of the 10" and 12" DIP discharges coming out of the submersible pumps (Total of 4 pumps with approx. 19 feet of piping each) Contractor shall structurally rehabilitate both sections of the existing wet well as shown in drawings. Contractor to coordinate with City and provide by-pass pumping provisions to guarantee operation of the plant without interruption and shall provide a traffic control plan for the duration of the by-pass pumping. The scope of the structural modifications includes pressure cleaning and safe collection and disposal of grit and debris inside the Lift Station (both sections). After preliminary inspection, Contractor to saw cut driveway and demolish the concrete as necessary and shown on the drawings, and dig to expose the top slab. This shall be done in such a way as to not collapse the structure. Demolish and safely remove the top slab and grout on the bottom slab. Contractor to provide URETEK sealant behind existing walls to water proof Lift Station from the outside as directed by Engineer after inspection. Contractor to construct new interior walls (include sewer pipe extension and wall penetration barrier) and top slab as shown on the plans. Contractor to grout from the invert of the influent pipe to the bottom of the existing wall penetrations between chambers. Contractor shall provide and install 2 x 8 inch DIP air vents with activated carbon canisters installed over 18' el. Carbon canisters to be installed in such a way to allow easy access (as shown in drawings). Contractor to provide final protective coating on all internal concrete faces of the lift station in both chambers.

1.03 WORK SEQUENCE

A. The CONTRACTOR is required to determine his own method of construction and detailed work sequence so long as the restraints are observed and the overall project completion time is achieved (identified in the Contract Documents).

B. The CONTRACTOR shall, prior to notice to proceed, prepare and submit a construction schedule to the Engineer for approval. The CONTRACTOR shall be advised that the existing wastewater treatment plant facilities are integral to the City of Seabrook sewage collection and treatment system and as such must remain operable through-out the construction period of the project. The scope of work shall be scheduled by the Contractor and coordinated with the Engineer/Operator to maintain operation of the facilities.

C. By-pass pumping will be accomplished by the CONTRACTOR in coordination with City Operator. Contractor to provide schedule and plan description of the by-pass to perform Lift Station work. All other portions of the facilities that have to be dewatered such as Clarifier # 2, will be done by the CONTRACTOR in a manner acceptable to the Engineer/Operator. The CONTRACTOR shall submit his plan for dewatering and temporary by-passing of Clarifier and Lift station to the Engineer for approval and shall notify the Engineer and the City of Seabrook Operator prior to any such activities.

1.04 CONSTRUCTION CRITERIA

A. The CONTRACTOR shall maintain all public streets in a condition such that vehicles and pedestrian traffic may be maintained at all times. All excavated material, construction materials, construction equipment, and construction vehicles shall be placed so as not to cause traffic hazards. If CONTRACTOR'S operations cause traffic hazards, CONTRACTOR shall repair the road surface, provide temporary ways, erect wheel guards or fences or take other measures for safety satisfactory to the ENGINEER and the OWNER.

B. The CONTRACTOR shall take all necessary precautions to prevent injury to the public in the construction area. Such precautions shall include, but not necessarily be limited to, the use of flagmen, the use of police, the erection of warning signs and/or the use of other means required by the OWNER. The CONTRACTOR shall be fully responsible for damage and injuries whether or not precautions have been provided.

C. The CONTRACTOR shall sequence all work such that at least one lane is open to traffic in all public streets at all times. At all times that one traffic lane must be closed, the CONTRACTOR's Traffic Control Plan shall include uniformed flagmen. Also, work shall be sequenced such that all lanes of traffic are open and vehicular access is provided to all businesses and residences on Saturdays, Sundays, and Holidays.

D. When detours are necessary, CONTRACTOR shall provide all necessary barriers, warning and direction signs, warning lights, flagmen, police protection, and/or any other protective devices required by the OWNER. The CONTRACTOR shall request detours from, coordinate with, and secure the required permits from the OWNER.

E. The CONTRACTOR shall be responsible for the preservation of all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part

of the CONTRACTOR, such property shall be restored by the CONTRACTOR, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manners acceptable to the ENGINEER.

F. During the course of the work, the CONTRACTOR shall keep the site of his operations in as clean and neat a condition as is possible. He shall dispose of all residue resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. Execute all work. The work of this Contract is generally specified in the Construction Documents.

B. Arrange for the securing of any necessary permits and pay for the same.

C. Arrange for the necessary temporary water service and pay for this service and all water consumed during the construction work.

D. Provide adequate temporary sanitary facilities.

E. Secure all necessary building permits and furnish, install, maintain, and remove all temporary electric service facilities for construction purposes, and pay for all electrical energy consumed for construction purposes, until final acceptance by the OWNER or until the ENGINEER certifies Substantial Completion. CONTRACTOR shall be responsible for determining the total temporary electrical need and shall provide it accordingly. The temporary electrical service shall meet NEC, OSHA, and all other local safety codes.

F. Provide and pay for temporary service for lighting of temporary facilities.

G. Provide initial and replacement lamps, wiring, switches, sockets, and other necessary electrical equipment required for temporary lighting and for small power tools.

H. Provide wiring, equipment, and connections for portable or temporary heating units.

I. Provide temporary heater; make all arrangements and pay all fuel costs; supervise and maintain all heating units.

J. Provide adequate dewatering of the site as required for the work throughout the time required to complete the work as shown on the Plans and specified hereinafter.

K. Provide all other temporary facilities, services, and all items as called for in the Contract Documents.

L. CONTRACTOR shall be responsible to locate all underground utilities, pipelines, conduits, etc. for obstructions to the project as designed prior to commencing construction. CONTRACTOR shall notify engineer of said obstructions.

M. Field verifications and modifications to design locations shall be considered incidental to project and included in the unit price bid found in these Construction Documents.

END OF SECTION

Section 01026

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SECTION INCLUDES

Preparation and submittal of a Schedule of Values for stipulated price contracts or for major lump sum items on unit price contracts for which the Contractor requests progress payments.

1.02 DEFINITION

A. The Schedule of Values is an itemized list that establishes the value of each part of the Work for a stipulated price contract or for major lump sum items. The Schedule of Values is used as the basis for preparing applications for payments. Quantities and unit prices may be included in the schedule when approved by or required by the Engineer.

B. A major lump sum item is a lump sum item in the Schedule of Unit Price Work, which qualifies as Major Unit Price Work as defined in Section GC - General Conditions.

1.03 PREPARATION

A. For stipulated price contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous geographic areas. Then organize each portion using the Table of Contents of this Project Manual as an outline for listing the value of work by Sections. A pro rata share of mobilization, bonds, and insurance may be listed as separate items for each portion of the work.

B. For unit price contracts, items should include a proportional share of Contractor's overhead and profit so that the total of all items will equal the Contract Price.

C. For lump sum equipment items where submittal of operation/maintenance data and testing are required, include a separate item for equipment operation and maintenance data submittal valued at 5 percent of the lump sum amount and a separate item for testing and adjusting valued at 5 percent of the lump sum amount.

D. Round off figures for each listed item to the nearest $100.00 except for the value of one item, if necessary, to make the total of all items in the Schedule of Values equal the Contract Price for stipulated price contracts or the lump sum amount in the Schedule of Unit Price Work.

E. Type the schedule of values on 8-1/2-inch by 11-inch white bond paper.

1.04 SUBMITTAL

A. Submit the Schedule of at least 10 days prior to submitting the first application for progress payment.

B. Revise the Schedule of Values and resubmit for items affected by contract modifications, change orders, and work change directives. After the changes are approved by the Engineer, make the submittal at least 10 days prior to submitting the next application for progress payment.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

Section 01255

CHANGE ORDER PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for processing Change Orders, including:

1. Assignment of a responsible individual for approval and communication of changes in the Work;

2. Documentation of change in Contract Price and Contract Time;

3. Change procedures, using proposals and construction contract modifications, work change directive, stipulated price change order, unit price change order, time and materials change order;

4. Execution of Change Orders;

5. Correlation of Contractor submittals.

1.02 REFERENCES

A. Rental Rate Blue Book for Construction Equipment (Data Quest Blue Book). Rental Rate is defined as the full unadjusted base rental rate for the appropriate item of construction equipment.

1.03 RESPONSIBLE INDIVIDUAL

A. Contractor shall provide a letter indicating the name and address of the individual authorized to execute change documents, and who shall also be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. The information shall be provided at the Preconstruction Conference.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Contractor shall maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Contractor shall document each proposal for a change in cost or time with sufficient data to allow evaluation of the proposal.

C. Proposals shall include, as a minimum, the following information as applicable:

1. Quantities of items in the original Section 00300 – Bid Form with

additions, reductions, deletions, and substitutions.

2. When Work items were not included in the Bid Form, Contractor shall provide unit prices for the new items, with supporting information as required by the Engineer.

3. Justification for any change in Contract Time.

4. Additional data upon request.

D. For changes in the Work performed on a time-and-material basis, the following additional information may be required:

1. Quantities and description of products and equipment.

2. Taxes, insurance and bonds.

3. Dates and times work was performed, and by whom.

4. Invoices and receipts for products, rented equipment, and subcontracts, similarly documented.

E. For changes in the work performed on a time-and-materials basis, rental equipment will be paid as follows:

1. Rented equipment will be paid by actual invoice cost for the duration of time required to complete the extra work without markup for overhead and profit. If the extra work comprises only a portion of the rental invoice where the equipment would otherwise be on the site, the Contractor shall compute the hourly equipment rate by dividing the actual monthly invoice by 176. (One day equals 8 hours and one week equals 40 hours.)

2. Operating costs shall not exceed the estimated operating costs given in the Blue Book for the item of equipment. Overhead and profit will be allowed on operating cost.

F. For changes in the work performed on a time-and-materials basis using Contractor-owned equipment, use Blue Book rates as follows:

1. Contractor-owned equipment will be paid at the Blue Book Rental Rate for the duration of time required to complete the extra work without markup for overhead and profit. The Rental Rate utilized shall be the lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of the Rental Rate for double shifts (one extra shift per day) and 200 percent of the Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of the appropriate Rental Rate shown in the Blue Book. No other rate adjustments shall apply.

2. Operating costs shall not exceed the estimated operating costs given in the Blue Book for the item of equipment. Overhead and profit will be allowed on operating cost. Operating costs will not be allowed for equipment on standby.

1.05 CHANGE PROCEDURES

A. Changes to Contract Price or Contract Time can only be made by issuance of a change order. All changes will be in accordance with the requirements of the General Conditions.

B. The Engineer will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time as authorized by the General Conditions by issuing supplemental instructions.

C. Contractor may request clarification of Drawings, Specifications or Contract Documents or other information. Response by the Engineer to a Request for Information does not authorize the Contractor to perform tasks outside the scope of the Work. All changes must be authorized as described in this section.

1.06 PROPOSALS AND CONTRACT MODIFICATIONS

A. The Engineer may also request a proposal in the response to a Request for Information. Contractor shall prepare and submit a proposal within 7 days or as specified in the request.

B. The Contractor may propose an unsolicited change by submitting a proposal to the Engineer describing the proposed change and its full effect on the Work, with a statement describing the reason for the change and the effect on the Contract Price and Contract Time including full documentation.

1.07 WORK CHANGE DIRECTIVE

A. The Engineer may issue a signed Work Change Directive instructing the Contractor to proceed with a change in the Work. A Work Change Directive will subsequently be incorporated in a Change Order.

B. The document will describe changes in the Work and will designate a method of determining any change in Contract Price or Contract Time.

C. Contractor shall proceed promptly to execute the changes in the Work in accordance with the Work Change Directive.

1.08 STIPULATED PRICE CHANGE ORDER

A. A stipulated price Change Order will be based on an accepted proposal including the Contractor's lump sum price quotation with Schedule of Values.

1.09 UNIT PRICE CHANGE ORDER

A. Where Unit Prices for the affected items of Work are included in Section 00300 – Bid Form, the unit price Change Order will be based on the unit prices, subject to Articles 7 and 9 of the General Conditions.

B. Where unit prices of Work are not pre-determined in the Section 00300 – Bid Form, the Work Change Directive or accepted proposal will specify the unit prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

A. Contractor shall provide an itemized account and supporting data after completion of change, within time limits indicated for claims in the General Conditions.

B. Engineer will determine the change allowable in Contract Price and Contract Time as provided in the General Conditions.

C. Contractor shall maintain detailed records of work done on time-and-material basis as specified in paragraph 1.04, Documentation of Change in Contract Price and Contract Time.

D. Contractor shall provide full information required for evaluation of changes and shall substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

A. Engineer will issue Change Orders, Work Change Directives, or accepted proposal for signatures of parties as described in the General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

A. For Stipulated Price Contracts, Contractor shall promptly revise the Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item.

B. For Unit Price Contracts, the next monthly estimate of work after acceptance of a Change Order will be revised to include any new items not previously included and the appropriate unit rates.

C. Contractor shall promptly revise progress schedules to reflect any change in Contract Time, and shall revise schedules to adjust time for other items of work affected by the change, and resubmit for review.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01270

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected products.

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 Items listed in Section 00300 – Bid Form shall govern**.

B. The Engineer will take all measurements and compute quantities accordingly.

C. Contractor shall assist by providing necessary equipment, workers, and survey personnel as required by the Engineer.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Engineer shall determine payment as stated in Article 9 of the General Conditions.

B. If the actual Work requires greater or lesser quantities than those quantities indicated in the Bid Form, provide the required quantities at the unit prices contracted, except as otherwise stated in Article 9 of the General Conditions.

C. Items of work required for completion of the project, but not listed in Section 00300 – Bid Form are considered incidental to the items listed. The cost of incidental work is to be included in the listed pay items.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Weight: Reinforcing steel, rolled or formed steel, fittings, or other metal shapes will be measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies will be measured by CRSI or AISC Manual of Steel Construction or scale weights.

B. Measurement by Volume:

1. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.

2. Excavation and Embankment Materials: Measured by cubic dimension using the average end area method.

C. Measurement by Area: Measured by square dimension using mean length and width or radius.

D. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

E. Stipulated Price Measurement: By unit designated in the agreement.

F. Other: Items measured by weight, volume, area, or lineal means or combination, as appropriate, as a completed item or unit of the Work.

1.05 PAYMENT

A. Payment Includes: Full compensation for all required supervision, labor, products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or installation of an item of the Work; and Contractor's overhead and profit.

B. Total compensation for required Unit Price Work shall be included in Unit Price bid in Section 00300 – Bid Form. Claims for payment as Unit Price Work, but not specifically covered in the list of unit prices contained in Section 00300, will not be accepted.

C. Interim payments for stored materials will be made only for materials to be incorporated under items covered in unit prices, unless disallowed in Supplementary Conditions.

D. Progress payments will be based on the Engineer's observations and evaluations of quantities incorporated in the Work multiplied by the unit price.

E. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities determined by Engineer multiplied by the unit price for Work which is incorporated in or made necessary by the Work.

1.06 NONCONFORMANCE ASSESSMENT

A. Remove and replace the Work, or portions of the Work, not conforming to the Contract Documents.

B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct one of the following remedies:

1. The nonconforming Work will remain as is, but the unit price will be adjusted to a lower price at the discretion of Engineer.

2. The nonconforming Work will be modified as authorized by the Engineer, and the unit price will be adjusted to a lower price at the discretion of the Engineer, if the modified work is deemed to be less suitable than originally specified.

C. Specification sections may modify the above remedies or may identify a specific formula or percentage price reduction.

D. The authority of the Engineer to assess the nonconforming work and identify payment adjustment is final.

1.07 NONPAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable to Engineer.

2. Products determined as nonconforming before or after placement.

3. Products not completely unloaded from transporting vehicle.

4. Products placed beyond the lines and levels of the required Work.

5. Products remaining on hand after completion of the Work, unless specified otherwise.

6. Loading, hauling, and disposing of rejected products.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

Section 01321

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Photographic requirements for construction photographs and submittals.

1.02 SUBMITTALS

A. Refer to Section 01330 for submittal requirements.

B. Prints: Prepare 2 prints of each view and submit 1 print directly to the Engineer within 7 days of taking photographs. One print shall be retained by the Contractor in the field office at the Project site and available at all times for reference.

C. Extra Prints: When requested by the Engineer, the Contractor shall submit extra prints of photographs, with distribution directly to designated parties who will pay the costs for the extra prints directly to the photographer.

D. When required by individual sections, submit photographs taken prior to start of construction to show original site conditions.

E. When required by Contract Documents, submit photographs monthly, with Pay Estimate.

1.03 QUALITY ASSURANCE

A. Contractor shall be responsible for the timely execution of the photographs, their vantage point, and quality.

PART 2 PRODUCTS

2.01 PRECONSTRUCTION PHOTOGRAPHS

A. Prior to the commencement of any construction, take 35mm or digital color photographs of the entire route of the project and present two set of prints to the City Engineer for their use in contract administration and inspection.

B. Photographs: Two prints; color, matte finish; 3 x 5 -inch size, mounted on 8-1/2 x 11- inch soft card stock, with left edge binding margin for three hole punch.

C. The photographs shall show on a non-reflective chalkboard readable in the photograph:

1. Job number.

2. Date and time photographs were taken.

3. Location of the photograph, house number and street, along with the project number.

D. Indicate the condition of the following:

1. Esplanades and boulevards.

2. Yards (near side and far side of street).

3. Housewalk and sidewalk.

4. Curb.

5. Area between walk and curb.

6. Particular features (yard light, shrubs, fences, trees, etc.).

7. Date shall be on negative or file.

8. Provide notation of vantage point marked for location and direction of shot, on a key plan of the site.

E. Sufficient number of photographs shall be taken to show the existence or non-existence of cracked concrete and the condition of trees, shrubs, and grass.

F. Identify each photograph with an applied label or rubber stamp on the back with the following information:

1. Name of the Project.

2. Name and address of the photographer (if a professional photographer is used).

3. Name of the Contractor.

4. Date the photograph was taken.

5. Photographs to be in plastic pockets and bound in three-ring notebook for easy access and viewing.

2.02 PROGRESS PHOTOGRAPHS

A. Take photographs at intervals, coinciding with the cutoff date associated with each application for payment. Select the vantage points for each shot each month

to best show the status of construction and progress since the last photographs were taken.

1. Vantage Points: Follow direction by the Engineer to select vantage points. During each of the following construction phases take not less than 2 of the required shots from the same vantage point each time to create a time-lapse sequence.

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values.

2. Construction Schedules.

3. Shop Drawings, Product Data, and Sampler

4. Operations and Maintenance Data.

5. Manufacturer's Certificates.

6. Construction Photographs.

7. Project Record Documents.

8. Design Mixes.

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. Schedule submittals well in advance of the need for the material or equipment for construction. Allow time to make delivery of material or equipment after submittal is approved.

2. Develop a submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. The Engineer will review and return submittals to the Contractor as expeditiously as possible but the amount of time required for review will vary depending on the complexity and quantity of data submitted. In no case will a submittal schedule be acceptable which allows less than 30 days for initial review by the Engineer. This time for review shall in no way be justification for delays or additional compensation to the Contractor.

3. The Engineer's review of submittals covers only general conformity to the Drawings, Specifications and dimensions which affect the layout. The Contractor is responsible for quantity determination. No quantities will be verified by the Engineer. The Contractor is responsible for any errors,

omissions or deviations from the Contract requirements; review of submittals in no way relieves the Contractor from his obligation to furnish required items according to the Drawings and Specifications.

4. Submit 5 copies of documents unless otherwise specified in the following paragraphs or in the Specifications.

5. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

6. The Contractor shall assume the risk for material or equipment which is fabricated or delivered prior to approval. No material or equipment shall be incorporated into the Work or included in periodic progress payments until approval has been obtained in the specified manner.

B. Transmittal Form and Numbering:

1. Transmit each submittal to the Engineer with a Transmittal Form. A copy of the Transmittal Form is attached.

2. 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 resubmittal of Submittal 2 or 15C for third resubmittal of Submittal 15). Each submittal shall only contain one type of work, material, or equipment. Mixed submittals will not be accepted.

3. Identify variations from requirements of Contract Documents and identify product or system limitations.

4. For submittal numbering of video tapes, see paragraph 1.10 Video.

C. Contractor's Stamp:

1. Apply Contractor's stamp, certifying that the items have been reviewed in detail and are correct and in accordance with Contract Documents, except as noted by any requested variance.

2. As a minimum, Contractor's Stamp shall include:

   a. Contractor's name.

   b. Job number.

   c. Submittal number.

   d. Certification statement that the Contractor has reviewed the submittal and it is in compliance with the Contract Documents.

   e. Signature line for Contractor.

1.03 SCHEDULE OF VALUES

A. Submit a Schedule of Values in accordance with Section 01292 – Schedule of Values.

1.04 CONSTRUCTION SCHEDULES

A. Submit Construction Schedules as provided in Project Manual.

1.05 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Submit shop drawings in accordance with Section 01340 - Shop Drawings, Product Data, and Samples.

1.06 OPERATIONS AND MAINTENANCE DATA

A. Submit Operations and Maintenance data in accordance with Section 01782 – Operations and Maintenance Data.

1.07 MANUFACTURER'S CERTIFICATES

A. When specified in Specification sections, submit manufacturers' certificate of compliance for review by Engineer.

B. Contractor's Stamp, as described in paragraph 1.02C, shall be placed on front page of the certification.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Certificates may be recent or previous test results on material or product, but must be acceptable to the Engineer.

1.08 CONSTRUCTION PHOTOGRAPHS

A. Submit Construction Photographs in accordance with Section 01321 - Construction Photographs.

1.09 PROJECT RECORD DOCUMENTS

A. Submit Project Record Documents in accordance with Section 01785 – Project Record Documents.

1.10 DESIGN MIXES

A. When specified in Specifications, submit design mixes for review.

B. Contractor's Stamp, as described in paragraph 1.02C, shall be placed on front page of each design mix.

C. 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.

D. Maintain a copy of approved design mixes at mixing plant.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

Section 01340

SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Methods, schedule, and process to be followed for shop drawings, product data and sample submittals.

1.02 REQUIREMENT

A. Submit shop drawings, product data and samples as required by the General Conditions and as designated in the Specifications using the procedures specified in Section 01330 - Submittal Procedures and the requirements of this Section.

B. Shop drawings, product data and samples are not considered Contract Documents.

1.03 SHOP DRAWING/SUBMITTAL SCHEDULE

A. Submit a separate Shop Drawing/Submittal schedule at the same time the construction schedule is submitted. List products, materials and equipment for which Shop Drawings and other submittals are required in the order in which they appear in the Specifications. Including product data and sample submittals in schedule.

1.04 SHOP DRAWINGS

A. Submit shop drawings for review as required by the Specifications. Have shop drawings reviewed and signed by a registered professional.

B. Place Contractor's Stamp on each drawing as described in Section 01300 - Submittal Procedures.

C. On the drawings, show accurately and distinctly, the following:

1. Field and erection dimensions clearly identified as such;

2. Arrangement and section views;

3. Relation to adjacent materials or structure, including complete information for making connections between work under this Contract and work under other contracts;

4. Kinds of materials and finishes;

5. Parts list and descriptions;

6. Assembly drawings of equipment components and accessories showing their respective positions and relationships to the complete equipment package;

7. Where necessary for clarity, identify details by reference to drawing sheet and detail numbers, schedule or room numbers as shown on the Contract Drawings.

D. Make drawings to scale providing a true representation of the specific equipment or item to be furnished.

1.05 PRODUCT DATA

A. Submit product data for review as required in Specification sections.

B. Place Contractor's Stamp, on each data item submitted, as described in Section 01330 - Submittal Procedures.

C. Mark each copy to identify applicable products, models, options to be used in this Project. Supplement manufacturers' standard data to provide information unique to this Project, where required by the Specifications.

D. For products specified only by reference standard, give manufacturers, trade name, model or catalog designation and applicable reference standard.

1.06 SAMPLES

A. Submit samples for review as required by the Specifications. Have samples reviewed and signed by a registered professional.

B. Place Contractor's Stamp on each sample or a firmly attached sheet of paper, as described in Section 01330 - Submittal Procedures.

C. Submit the number of samples specified in Specifications; one of which will be retained by the Engineer.

D. Reviewed samples which may be used in the Work are identified in Specifications.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01450

CONTRACTOR'S QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality assurance and control of installation and manufacturer's field services and reports.

1.02 MEASUREMENT AND PAYMENT

A. No payment will made for this item. Include the cost of Contractor's quality control in overhead cost for this project.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' installation instructions, including each step in sequence.

C. Request clarification from the Engineer before proceeding should manufacturers' instructions conflict with Contract Documents.

D. Comply with specified standards as minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce the specified level of workmanship.

1.04 REFERENCES

A. Obtain copies of standards and maintain at job site when required by individual Specification sections.

1.05 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification sections, provide material or product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, operator training, test, adjust, and balance of equipment as applicable, and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training if defined in Specification sections.

B. At the Engineer's request, submit qualifications of manufacturer's representative to the Engineer 15 days in advance of required representative's services. The representative shall be subject to approval of the Engineer.

C. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions. Submit report within 14 days of observation to the Engineer for review.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

Section 01452

INSPECTION SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Inspection services and references

1.2 INSPECTION

A. The Engineer will appoint an Inspector as a representative of the Owner to perform inspections, tests, and other services specified in individual specification Sections

B. Alternately, the Engineer may appoint, employ, and pay an independent firm to provide additional inspection or construction management services as indicated in Section 01454 - Testing Laboratory Services.

C. Reports will be submitted by the independent firm to the Engineer, Architect/Engineer, and Owner, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

D. Assist and cooperate with the Inspector; furnish samples of materials, design mix, equipment, tools, and storage.

E. Notify the Engineer 24 hours prior to expected time for operations requiring services. Notify Architect/Engineer and independent firm when noted.

F. Sign and acknowledge report for Inspector.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

Section 01454

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing laboratory services and Contractor responsibilities related to those services.

1.02 REFERENCES

A. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

B. ASTM D 3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

C. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D. ASTM E 329 - Standard Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

E. ISO/TEC Guide 25 - General Requirements for the Competence of Calibration and Testing Laboratories.

1.03 SELECTION AND PAYMENT

A. The District will select, employ, and pay for services of an independent testing laboratory to perform inspection and testing identified in Part 3 of individual Specification sections.

B. Employment of a testing laboratory by the District shall not relieve Contractor of its obligation to perform work in accordance with requirements of Contract documents.

C. The District will deduct a minimum two-hour charge for testing laboratory time from periodic progress payment when operations requiring testing or inspection are canceled without prior notification.

D. The District will deduct cost of retesting from periodic progress payment whenever failed work is removed, replaced and retested.

1.04 QUALIFICATION OF LABORATORY

A. Meet laboratory requirements of ASTM E 329 and applicable requirements of ASTM C 1077, ASTM D 3666, and ASTM D 3740.

B. Meet ISO/TEC Guide 17025 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Specification sections.

C. If laboratory subcontracts are part of the testing services, such work will be placed with a laboratory complying with the requirements of this Section.

1.05 LABORATORY REPORTS

A. Testing laboratory shall provide and distribute copies of laboratory reports to the distribution list Project Manager provides at the pre-construction conference.

B. Keep one copy of each laboratory report distributed or faxed at the site field office for duration of the Work.

C. Laboratory will fax material supplier, Contractor and Project Manager reports that indicate failing test results by no later than close of business on the working day following test completion and review.

1.06 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge requirements of the Contract.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume Contractor duties.

D. Laboratory has no authority to stop the Work.

1.07 CONTRACTOR RESPONSIBILITIES

A. Provide safe access to the Work and to manufacturer's facilities for Project Manager and for testing laboratory personnel.

B. Provide testing laboratory with a copy of the Construction Schedule and a copy of each update to Construction Schedule.

C. Notify Project Manager and testing laboratory during normal working hours of the day previous to expected time for operations requiring inspection and testing services. When Contractor fails to make timely prior notification, do not proceed with the operations requiring inspection and testing services.

D. Notify Design Consultant 24 hours in advance when Specification requires presence of Design Consultant for sampling or testing.

E. Request and monitor testing as required to provide timely results and to avoid delays to the Work. Provide samples to laboratory in sufficient time to allow required test to be performed in accordance with specified test methods before intended use of the Product.

F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested, to obtain and handle samples at site or at source of Products to be tested, and to facilitate tests and inspections including storage and curing of test samples.

G. Make arrangements with laboratory through Project Manager. Payment for additional testing will be made in accordance with Document 00700 - General Conditions:

1. Re-testing required for failed tests.

2. Re-testing for nonconforming work.

3. Additional sampling and tests requested beyond specified requirements.

4. Insufficient notification of cancellation of tests for work scheduled but not performed.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.01 CONDUCTING TESTING

A. Conform to laboratory sampling and testing methods specified in individual Specification sections to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by Project Manager.

B. Requirements of this Section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by employed testing laboratories.

END OF SECTION

Section 01506
DIVERSION PUMPING

PART 1 GENERAL

1.01 DEFINITIONS

A. Diversion-pumping: Installation and operation of bulkheads, plugs, hoses, piping, and pumps required to maintain sewer plant effluent flow and prevent backups and overflows.

1.02 SYSTEM DESCRIPTION

A. Provides continuous sewer service to users of sewer systems while maintenance or construction operations are in progress, by diverting flow around construction locations. Maintain sewer effluent flow to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways.

B. When pumps are operating, have an experienced operator on site to monitor operation, adjust pumps, make minor repairs to system, and report problems.

C. Diverted flow pumped from the existing chlorine contact basin around dechlorination basin to the outfall must be measured and recorded for reporting to the TCEQ.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittals Procedures.

B. Submit a Diversion Pumping Plan prior to installation. Show location, number and size of pumps, number, location, size and type of hoses or rigid piping, and location of downstream discharge; and special features where pipes or hoses cross roadways, temporary trenches, support bridges. Include equipment for measuring and recording flow.

1.04 SCHEDULING

A. Coordinate diversion pumping operations with Owner and Operator.

PART 2 PRODUCTS

2.01 MATERIALS

A. Design piping, joints and accessories to withstand at least twice maximum system pressure or 50 psi, whichever is greater.

B. Use self-priming type or submersible electric pumps, with a working pressure gauge on the discharge.

PART 3 E X E C U T I O N

3.01 FIELD QUALITY CONTROL

A. During diversion pumping, do not allow sewage plant effluent to leak, dump, or spill into or onto areas outside of existing sanitary sewer systems.

B. In the event of an accidental spill or overflow, immediately stop discharge and take action to clean up and disinfect spill. Promptly notify Owner and Operator so required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA).

3.02 CLEANING

A. When diversion-pumping operations are complete, drain sewage plant effluent within piping into sanitary sewers prior to disassembly.

END OF SECTION

Section 01576

WASTE MATERIAL DISPOSAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.02 UNIT PRICES

A. No separate payment will be made for waste material disposal under this Section. Include payment in unit price for related sections.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittal Procedures.

B. Submit a copy of an approved Permit, issued by the Flood Plain Manager having jurisdiction over the site, prior to disposal of excess material in areas designated as being in a "100-year Flood Hazard Area".

C. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances.

D. Submit a copy of written permission from property owner, along with description of property, prior to disposal of excess material adjacent to the Project. Submit a written and signed release from property owner upon completion of disposal work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 SALVAGEABLE MATERIAL

A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at a location selected by the Contractor and approved by the Engineer.

B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material shall be disposed of offsite to a location selected by the Contractor and approved by the Engineer.

C. Pipe Culvert: Load culverts shall be disposed of offsite to a location selected by the Contractor and approved by the Engineer.

D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.

E. Confirm with owner on all mechanical equipment before disposal or removal from site.

3.02 EXCESS MATERIAL

A. Vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage, shall become the property of Contractor and shall be removed from the job site and legally disposed of.

B. Excess soil may be deposited on private property adjacent to the Project when written permission is obtained from property owner. See Paragraph 1.03 D above.

C. Verify the flood plain status of any proposed disposal site. Do not dispose of excavated materials in an area designated as within the 100-year Flood Hazard Area unless a Permit has been obtained. Excess material placed in a "100-year Flood Hazard Area" without a Permit, shall be removed by Contractor at no additional cost to the Owner.

D. Waste materials shall be removed from the site on a daily basis, such that the site is maintained in a neat and orderly condition.

END OF SECTION

Section 01578

CONTROL OF GROUND WATER AND SURFACE WATER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations, and foundation beds in a stable condition, and controlling ground water conditions for tunnel excavations.

B. Protecting work against surface runoff and rising floodwaters.

C. Disposing of removed water.

1.02 METHOD OF PAYMENT

A. Measurement for control of ground water and surface water, if included in Document 00300-Bid Form, will be on either a lump sum basis or a linear foot basis for continuous installations of wellpoints, eductor wells, or deep wells.

B. If not included in the unit price schedule, include the cost to control ground water and surface water in unit price for work requiring such controls.

C. Follow Section 01290- Payment Procedures for unit price procedures.

1.03 REFERENCES

A. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49 kg) Rammer and 12-inch (304.8 mm) Drop.

B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

C. Federal Register 40 CFR (Vol. 55, No. 222) Part 122, EPA Administered Permit Programs (NPDES), Para.122.26(b)(14) Storm Water Discharge.

1.04 DEFINITIONS

A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.

1. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts, and disposing of removed water. The intent of dewatering is to increase stability of tunnel excavations and excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; reduce lateral

loads on sheeting and bracing; improve excavating and hauling characteristics of excavated material; prevent failure or heaving of the bottom of excavations; and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom or instability of tunnel excavations.

B. Excavation drainage includes keeping excavations free of surface and seepage water.

C. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.

D. Equipment and instrumentation for monitoring and control of the ground water control system includes piezometers and monitoring wells, and devices, such as flow meters, for observing and recording flow rates.

1.05 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems.

B. Design a ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 01561 - Trench Safety Systems, to produce the following results:

1. Effectively reduce the hydrostatic pressure affecting:

a. Excavations.

b. Tunnel excavation, face stability or seepage into tunnels.

2. Develop a substantially dry and stable subgrade for subsequent construction operations.

3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.

4. Prevent the loss of fines, seepage, boils, quick condition, or softening of the foundation strata.

5. Maintain stability of sides and bottom of excavations.

C. Provide ground water control systems may include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from any other source entering the excavation. Excavation drainage may include placement of drainage materials, such as crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of the system to protect property as required.

H. Provide an adequate number of piezometers installed at the proper locations and depths as required to provide meaningful observations of the conditions affecting the excavation, adjacent structures, and water wells.

I. Provide environmental monitoring wells installed at the proper locations and depths as required to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into the work area or into the ground water control system.

J. Decommission piezometers and monitoring wells installed during design phase studies and left for Contractors monitoring and use.

1.06 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittals.

B. Submit a Ground Water and Surface Water Control Plan for review by the Engineer prior to start of any field work. The Plan shall be signed by a Professional Engineer registered in the State of Texas. Submit a plan to include the following:

1. Results of subsurface investigation and description of the extent and characteristics of water bearing layers subject to ground water control.

2. Names of equipment suppliers and installation subcontractors.

3. A description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria, and operation and maintenance procedures.

4. A description of proposed monitoring and control system indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics.

5. A description of proposed filters including types, sizes, capacities and manufacturer's application recommendations.

6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.

7. Operating requirements, including piezometric control elevations for dewatering and depressurization.

8. Excavation drainage methods including typical drainage layers, sump pump application and other necessary means.

9. Surface water control and drainage installations.

10. Proposed methods and locations for disposing of removed water.

C. Submit the following records upon completed initial installation:

1. Installation and development reports for well points, eductors, and deep wells.

2. Installation reports and baseline readings for piezometers and monitoring wells.

3. Baseline analytical test data of water from monitoring wells.

4. Initial flow rates.

D. Submit the following records on a weekly basis during operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers, and monitoring wells.

E. Submit the following records at end of work. Decommissioning (abandonment) reports for monitoring wells and piezometers installed by other during the design phase and left for Contractor's monitoring and use.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain all necessary permits from agencies with control over the use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Because the review and permitting process may be lengthy, take early action to pursue and submit for the required approvals.

D. Monitor ground water discharge for contamination while performing pumping in the vicinity of potentially contaminated sites.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Equipment and materials are at the option of Contractor as necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review of the Engineer through submittals required in Paragraph 1.06, Submittals.

B. Eductors, well points, or deep wells, where used, must be furnished, installed and operated by an experienced contractor regularly engaged in ground water control system design, installation, and operation.

C. All equipment must be in good repair and operating order.

D. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

PART 3 EXECUTION

3.01 GROUND WATER CONTROL

A. Perform a subsurface investigation by borings as necessary to identify water bearing layers, piezometric pressures, and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine the drawdown characteristics of the waterbearing layers. The results shall be presented in the Ground Water and Surface Water Control Plan (See Paragraph 1.06B.1).

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in a manner compatible with construction methods and site

conditions. Monitor effectiveness of the installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify the Engineer in writing of any changes made to accommodate field conditions and changes to the Work. Provide revised drawings and calculations with such notification.

D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify that the system lowers ground water piezometric levels at a rate required to maintain a dry excavation resulting in a stable subgrade for prosecution of subsequent operations.

F. Where hydrostatic pressures in confined water bearing layers exist below excavation, depressurize those zones to eliminate risk of uplift or other instability of excavation or installed works. Allowable piezometric elevations shall be defined in the Ground Water and Surface Water Control Plan.

G. Remove ground water control installations.

1. Remove pumping system components and piping when ground water control is no longer required.

2. Remove piezometers, including piezometers installed during the design phase investigations and left for Contractor's use, upon completion of testing, in accordance with Section 02533 - Acceptance Testing of Sanitary Sewers.

3. Remove monitoring wells when directed by the Engineer.

4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

G. During backfilling, dewatering may be reduced to maintain water level a minimum of 5 feet below prevailing level of backfill. However, do not allow that water level to result in uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement stabilized sand until at least 48 hour after placement.

H. Provide a uniform diameter for each pipe drain run constructed for dewatering. Remove pipe drain when it has served its purpose. If removal of pipe is impractical, provide grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout when pipe is removed from service.

I. Extent of construction ground water control for structures with a permanent perforated underground drainage system may be reduced, such as for units designed

to withstand hydrostatic uplift pressure. Provide a means of draining the affected portion of underground system, including standby equipment. Maintain drainage system during operations and remove it when no longer required.

J. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.

K. Compact backfill to not less than 95 percent of the maximum dry density in accordance with ASTM D 698.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between every eductor well or well point and discharge header so that discharge from each installation can be visually monitored.

B. Install sufficient piezometers or monitoring wells to show that all trench or shaft excavations in water bearing materials are predrained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for Contractor's selected method of work.

C. Install piezometers or monitoring wells not less than one week in advance of beginning the associated excavation.

D. Dewatering may be omitted for portions of underdrains or other excavations, but only where auger borings and piezometers or monitoring wells show that soil is predrained by an existing system such that the criteria of the ground water control plan are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change the methods, in the event that the installations according to the ground water control plan does not provide satisfactory results based on the performance criteria defined by the plan and by the specification. Submit a revised plan according to Paragraph 1.06B.

3.03 EXCAVATION DRAINAGE

A. Contractor may use excavation drainage methods if necessary to achieve well drained conditions. The excavation drainage may consist of a layer of crushed stone and filter fabric, and sump pumping in combination with sufficient wells for ground water control to maintain stable excavation and backfill conditions.

3.04 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while the ground water control installations or excavation drainage is operating in an area or seepage into tunnel is occurring. Keep system in good condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedule.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make observations, as specified.

D. Remove and grout piezometers inside or outside the excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by the Engineer.

3.05 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also monitor and record water level and ground water recovery. These records shall be obtained daily until steady conditions are achieved and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until the Work is completed or piezometers or wells are removed, except when the Engineer determines that more frequent monitoring and recording are required. Comply with the Engineer's direction for increased monitoring and recording and take measures as necessary to ensure effective dewatering for intended purpose.

3.06 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. The requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by such agencies.

END OF SECTION

Section 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Closeout procedures including final submittals such as operation and maintenance data, warranties, and spare parts and maintenance materials.

1.02 CLOSEOUT PROCEDURES

A. Comply with Section GC - General Conditions regarding Final Completion and Final Payment when Work is complete and ready for the Engineer's final inspection.

B. Provide Project Record Documents in accordance with Section 01785.

C. Complete or correct items on punch list, with no new items added. Any new items will be addressed during warranty period.

1.03 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to a sanitary condition.

D. Clean debris from drainage systems.

E. Clean site; sweep paved areas, rake clean landscaped surfaces.

F. Remove waste and surplus materials, rubbish, and temporary construction facilities from the site following the final test of utilities and completion of the work.

1.04 WARRANTIES

A. Provide one original of each warranty from Subcontractors, suppliers, and manufacturers.

B. Submit warranties prior to final Application for Payment.

C. Warranties shall commence in accordance with the requirements in Section GC - General Conditions, paragraph 14.04, Substantial Completion.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01785

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Maintenance and Submittal of Record Documents.

1.02 MAINTENANCE OF DOCUMENTS

A. Maintain one record copy of documents at the site in accordance with Section GC - General Conditions, paragraph 6.12, Record Documents.

B. Store Record Documents in field office if a field office is required by Contract Documents, or in a secure location. Provide files, racks, and secure storage for Record Documents and samples.

C. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

E. Keep Record Documents available for inspection by Engineer.

1.03 RECORDING

A. Record information concurrently with evaluation progress. Do not abandon work site until required information is recorded.

B. Drawings: Legibly record all actual work, or "as built" conditions observed in the field on the district overall plan provided by the Engineer when a discrepancy is noted.

1.04 SUBMITTALS

A. At contract closeout, deliver Project Record Documents to the Engineer.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 02136

WASTE MATERIAL HANDLING, TESTING AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

Handling, testing and disposal of hazardous and non-hazardous waste material.

A. Material present inside of existing tanks to be repaired or demolished, i.e., silt, sludge and other residue deposits generated by normal water production usage of the tanks.

B. Existing coatings removed from existing tanks.

C. Spent abrasives used and debris generated in the execution of the work.

D. All spent thinners, coating materials or other products brought on site for execution of work that require disposal as a hazardous or non-hazardous waste.

E. Soil that may be contaminated due to the execution of the work.

F. Petroleum soaked sand foundation material removed from demolished tank sites.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement and payment will be made for handling, testing or disposal of non- hazardous or hazardous material, debris or material identified as contaminated material on the site prior to the bid date except as indicated in section 1.02 B and 1.02 C. The Contractor shall include the cost for this work in the Contract bid price for work of which this is a component part.

B. Payment for hazardous waste material handling, removal, testing, transporting and disposal of material identified as hazardous after the bid date will be paid for at the unit price bid for "Hazardous Waste Handling, Removal, Transporting" if such an item is provided in the contract.

C. Removal and disposal of potentially petroleum soaked sand foundation material will be measured per cubic yard which shall include testing, removing, storing, transporting and disposing of material and will be paid for at the unit price bid for "Removal and Disposal of Potentially Petroleum Soaked Sand". Basis of payment will be Class I Industrial Waste having a Total Petroleum Hydrocarbon

(TPH) level greater than 1500 ppm.

1.3 REFERENCES

The following is a list of applicable requirements to this project. It is not intended to be a complete listing of all laws and regulations to which the Contractor must comply.

A. Environmental Protection Agency - Code of Federal Regulations

1. 40 CFR Part 261 - Identification and Testing of Hazardous Waste
2. 40 CFR 261, Appendix II EPA - Toxicity Characteristic Leaching Procedure
3. 40 CFR Part 262 - Standards Applicable to Generators of Hazardous Waste
4. 40 CFR Part 263 - Standards Applicable to Transporters of Hazardous Waste
5. 40 CFR Part 264 - Standards for Owner and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
6. 40 CFR Part 265 - Interim Status for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
7. 40 CFR 265, Subpart C EPA - Preparedness and Prevention
8. 40 CFR 265, Subpart D EPA - Contingency Plan and Emergency Procedures
9. 40 CFR 265.16 EPA - Personnel Training
10. 40 CFR Part 268 - Land Disposal Restrictions
11. 49 CFR Parts 173,178 and 179: (USDOT/ Hazardous Materials, Shipping, Containers.)
12. 40 CFR Part 355 - Emergency Planning and Notification

B. EPA Methods

1. 3050 - Acid Digestion of Sediment, Sludge, and Soils
2. SW 846 - Test Methods for Evaluating Solid Waste - Physical/Chemical Methods

C. Texas Commission on Environmental Quality

1. TAC Title 30, Chapter 305 "Consolidated Permits"

2. TAC Title 30, Chapter 335 "Industrial Solid Waste and Municipal Hazardous Waste"

3. TAC Title 30, Chapter 343 "Oil and Hazardous Substances"

D. TWC Technical Guidelines

1. Document #1, Waste Evaluation/Classification

E. NIOSH Methods

1. 7082 Lead

F. Society for Protective Coatings

1. SSPC 91-18 - Industrial Lead Paint Removal Handbook

2. Guide 6 - Guide for Containing Debris Generated During Paint Removal Operations

3. Guide 7 - Guide for the Disposal of Lead Contaminated Surface Preparation Debris

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 – Submittal Procedures.

B. Submittals shall conform to appropriate codes for regulatory requirements.

C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.

1.5 TESTING AND IDENTIFICATION

A. The Owner is the Generator of the debris for permitting purposes, and will obtain the EPA Identification number, but the Contractor is responsible for assuring that all testing, handling, storage, transportation, and disposal requirements are properly implemented, including satisfactory training of job site personnel and the cleaning of all reusable items and equipment prior to removal from the site.

B. Prior to the bid date, if testing has been performed by the City and if hazardous

material has been identified in the debris material in an existing tank, the paint to be removed from an existing tank, the work site soil, or the foundation material, the material or test results will be indicated in section 01110. It is the responsibility of the Contractor to properly test and to determine if any wastes generated as a result of this project are hazardous in accordance with 40 CFR Part 261.

1.6 DEFINITIONS

(Note Definitions applicable to this section are also presented elsewhere.)

A. Hazardous Waste (lead paint debris): Waste that is classified as hazardous due to its concentrations of regulated hazardous substances. Paint debris is classified as hazardous waste if, after testing by the Toxicity Characteristic Leaching Procedure (TCLP), the leachate contains any of the 8 metals or other substances in concentrations at or above limits established in 40 CFR 261.

B. Lead Containing Dust and Debris: Dust and debris generated during the project which contains lead in any amount, including but not limited to pulverized paint, spent abrasive, filters (wet and dry), and containment materials upon which lead is still present.

C. RCRA: Resource Conservation and Recovery Act. Federal law pertaining to hazardous waste management. EPA implementing regulations are contained in 40 CFR 240-280.

D. TACB: Texas Air Control Board. Texas State Agency joined into the TCEQ and responsible for writing and enforcement of rules and regulations relating to air quality.

E. TCEQ: Texas Commission on Environmental Quality. State of Texas Commission responsible for planning, oversight, monitoring and management of natural resources.

F. TCLP: Toxicity Characteristic Leaching Procedure. Laboratory tests conducted on wastes that determine the amount of hazardous materials that leach out into a test solution. The test is intended to simulate the properties of water as it leaches through a solid waste landfill. TCLP testing is defined in 40 CFR 261, Appendix II.

G. TWC: Texas Water Commission. Texas State Agency joined into the TCEQ and responsible for writing and enforcement of rules and regulations relating to water quality and solid waste programs.

PART 2 NOT USED

PART 3 EXECUTION

3.1 WASTE HANDLING AND STORAGE

A. All chemicals to be brought on site by the contractor must be stored and used in a safe and proper manner in accordance with all applicable Federal, State and local laws and regulations as well as the manufacturers recommendations. Material Safety Data Sheets (MSDSs) shall be maintained on-site for all hazardous chemicals used.

B. Hazardous wastes are to be handled and stored according to the requirements of TAC 30 Chapter 335 "Industrial Solid Waste and Municipal Hazardous Waste" and 40CFR Part 262, with regard to on-site storage, and 40CFR Part 264 with regard to required notices, site security, personnel training, contingency planning and emergency procedures, recordkeeping and reporting, time of storage, amount of material stored, and use of proper containers. Hazardous waste will be stored in covered containers in accordance with the requirements of 40 CFR 262 and 49 CFR 172,178 and 179.

C. The contractor shall provide proper, segregated storage for hazardous and non-hazardous materials to be used in the work area in order to ensure safe work conditions.

D. All material, waste and debris from removal of lead containing coatings, including those products and materials employed for chemical paint stripping , shall be considered hazardous waste and handled accordingly, until such time that testing and analysis indicates otherwise.

1. Sampling of materials for TCLP testing of initial containers of debris shall be completed prior to or during filling. Until the TCLP test results are received, the containers shall be labeled as lead-containing debris. Hazardous waste labels shall be applied after the test results are received, if the debris tests hazardous.

2. Hazardous waste shall not be stored at the project site for more than 90 days. Non- hazardous wastes shall be removed at a minimum of once per month (30 days).

3. Special attention shall be given to the time of storage, storage conditions, amount of material stored at any one time, use of proper containers, and personnel training.

E. Hazardous waste shall be placed on pallets over protected ground, be located in

a secure area enclosed by a fence with signs around the perimeter, and be shielded adequately to prevent dispersion of the waste by wind or water. Under no circumstances shall the waste be stored within a flood plain area. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken. The storage area shall be within a security fence with a locked gate.

3.2 ENVIRONMENTAL CONTAMINATION

The contractor shall not contaminate the air, soils or surface and ground waters with any hazardous waste. Spills, releases and discharges of hazardous or toxic materials which inadvertently occur shall be reported in accordance with 40 CFR 265 and TAC 30 Chapter 343.

A. Contingency Plan and Training: The Contractor shall comply with TCEQ Title 30 Regulations and EPA 40 CFR 265, Subpart C in the event of a spill or release of waste, EPA 40 CFR 265 Subpart D, and TCEQ regulations.

B. All personnel associated with the handling of hazardous waste shall complete a formal training program in accordance with 40 CFR 265.16 and TCEQ Title 30 Regulations. Training records of all employees must be maintained and kept on file.

3.3 WASTE CLASSIFICATION

A. Testing

1. All solid waste generated by the paint removal activities shall be tested in accordance with 40 CFR 261, Appendix II, Method 1311 Toxicity Characteristic Leaching Procedure (TCLP), to determine if it is hazardous.

2. In the case of wet methods of preparation, the use of chemical strippers, or containerized hygiene water, all liquids and sludge shall also be tested. When chemical strippers are used, the testing shall include pH to determine corrosivity. All waste water shall be tested for total lead.

3. Representative samples of the debris for each waste stream generated from the work on this project shall be collected. A minimum of four of the samples representative of each waste stream shall be analyzed to establish a waste is non-hazardous. Note that more than four initial samples of each waste stream shall be collected in order to obtain the four representative samples for analysis. Results from one test sample are sufficient to identify a waste as hazardous.

4. The collection of the initial representative samples of each waste stream and selection of the minimum of four for testing shall be accomplished using a random sampling technique and shall comply with the following: a minimum of one representative sample for each 55 gallons of waste, or a minimum of four representative samples for each gondola or roll-off box of waste. Samples shall be collected in accordance with SW-846, "Test Methods for Evaluating Solid Waste - Physical/ Chemical Methods".

5. Sampling and testing shall be performed by a certified laboratory acceptable to the Owner. The name, address, and qualifications of the laboratory shall be provided for approval. The Owner shall be provided with copies of the test results as soon as they are received by the Contractor.

B. Classification

1. Lead paint debris is classified as hazardous waste if, after testing by TCLP, the leachate contains any of the 8 metals or other hazardous substances in concentrations at or above limits established in 40 CFR 261:

Arsenic -	5.0 mg/L
Barium -	100.0 mg/L
Cadmium -	1.0 mg/L
Chromium -	5.0 mg/L
Lead -	5.0 mg/L
Mercury -	0.2 mg/L
Selenium -	1.0 mg/L
Silver -	5.0 mg/L

2. The above includes only the eight (8) characteristic metals listed by EPA among which are elements typically associated with paints. Other substances may be present which may cause debris to be classified as hazardous waste as defined in 40 CFR 261 (such as a pH <=2.0 or >=12.5 resulting in corrosivity), and must be taken into account.

3.4 DISPOSAL

A. The contractor shall arrange to have wastes and debris transported from the site in accordance with all City Ordinances and State and Federal Laws. If wastes and/or debris is determined to be hazardous, transporting to be in accordance with TAC 30 Chapter 335 -Industrial Solid Waste and Municipal Hazardous Waste, 40CFR Part 263 - Standards Applicable to Transporters of Hazardous Waste and the applicable sections of 49 CFR Parts 171 through 179.

B. Manifest and Reporting: The Contractor shall comply with all of the manifesting, certification, and reporting requirements of EPA 40 CFR 262, 40 CFR 268, and Texas regulations, including certificates of final disposal for each shipment.

C. Copies of all records and reports, test sample chain of custody forms, TCLP and other test results shall be provided to the Owner.

D. The contractor shall dispose of wastes and debris at a licensed site acceptable to the Owner. Hazardous wastes and debris shall be disposed of in accordance with 40CFR Part 265 and 40CFR Part 268 Land Disposal Restrictions. Manifesting of hazardous wastes shall be in accordance with 40CFR Part 262, Subpart B.

E. Waste water resulting from surface preparation, washing, personal hygiene or decontamination shall not be discharged without testing and through arrangement with the local Publicly Owned Treatment Works (POTW) or other approved means.

END OF SECTION

Section 02221

REMOVING EXISTING PAVEMENTS, STRUCTURES, WOOD, AND DEMOLITION DEBRIS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removing concrete paving, asphaltic concrete pavement, brick pavement and base courses.

B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.

C. Removing pipe culverts, sewers, and sewer leads.

D. Removing waterlines and water services lines including asbestos cement pipe per OSHA guidelines.

E. Removing existing inlets and manholes.

F. Removing and disposing of pre-stressed concrete beams and drill shafts.

G. Removing miscellaneous structures of concrete or masonry.

H. Removing existing bridge.

I. Removing existing wood and demolition debris.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for removing and disposing of asphaltic surfacing with or without base, regardless of thickness encountered, is on square yard basis measured between lips of gutters.

2. Payment for removing and disposing of reinforced concrete pavement, with or without asphalt overlay, regardless of its thickness, is on square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.

3. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on square yard basis.

4. Payment for removing and disposing of concrete sidewalks and driveways is on square yard basis.

5. Payment for removing asphaltic pavement surface by milling shall be in accordance with Section 2960.

6. Payment for removing and disposing of miscellaneous concrete and masonry is on cubic yard basis of structure in place.

7. Payment for removing and disposing of pipe culverts, sewers, and sewer leads, is on linear foot basis for each diameter and each material type of pipe removed.

8. Payment for removing and disposing of waterlines and water service lines including asbestos cement pipe is on linear foot basis for each diameter pipe and each material type of pipe removed.

9. Payment for removing and disposing of existing inlets is on unit price basis for each inlet removed.

10. Payment for removing and disposing of prestressed concrete piles and drill shafts is on linear foot basis.

11. Payment for removing and disposing of existing bridge, including piles and abutments to minimum of 4 feet below ground level, is on a lump sum basis.

12. Payment for removing and disposing of existing manholes is on unit price basis for each manhole removed.

13. Payment for removing and disposing of miscellaneous wood and demolition debris is on cubic yard basis.

14. No payment for saw cutting of pavement, curbs, or curbs and gutters will be made under this section. Include cost of such work in unit prices for items listed in bid form requiring saw cutting.

15. No payment will be made for work outside maximum payment limits indicated on Drawings, or for pavements or structures removed for Contractor's convenience.

    a. For utility installations: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings. Limits of measurement will be as shown on Street Cut Pavement Replacement Rules.

16. Refer to Section 01270 - Measurement and Payment for unit price procedures

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate removal work with utility companies.

C. For removal of asbestos containing materials, or material that could potentially contain asbestos, comply with applicable provisions of OSHA 29 CFR 1926.1101 – Asbestos, OSHA 29 CFR 1926.32 – General Safety and Health Provisions, and EPA 40 CFR 61 Subpart M – National Emission Standard for Asbestos.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Obtain advance approval from Project Manager for dimensions and limits of removal work.

B. Identify known utilities below grade. Stake and flag locations.

C. For removal of asbestos-containing materials, or materials that oculd potentially contain asbestos, comply with the following:

1. Crew members must be trained in accordance with OSHA 29 CFR 1926.1101 – Asbestos.

2. Conduct negative exposure assessment to demonstrate asbestos exposure below permissible exposure limit (PEL) in accordance with OSHA 29 CFR 1926.1101 – Asbestos and EPA 40 CFR 763 – Asbestos.

3. If negative exposure assessment not conducted, or if results are above PEL, provide respiratory protection in accordance with Paragraph 3.02 of this Section.

3.2 PROTECTION

A. Protect following from damage or displacement:

1. Adjacent public and private property.

2. Trees, plants, and other landscape features designated to remain.

3. Utilities designated to remain.

4. Pavement and utility structures designated to remain.

4. Bench marks, monuments, and existing structures designated to remain.

B. When required, provide respiratory protection in accordance with OSHA 29 CFR 1910.134 – Respiratory Protection, and National Institute of Occupational Safety and Health (NIOSH).

3.3 REMOVALS

A. Remove pavements and structures by methods that will not damage underground utilities. Do not use drop hammer near existing underground utilities.

B. Minimize amount of earth loaded during removal operations.

C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to minimum depth of 2 inches.

D. When street and driveway saw cut location is greater than one-half of pavement lane width, remove pavement for full lane width or to nearest longitudinal joint as directed by Project Manager.

E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.

F. Where existing end of pipe culvert or end of sewer is to remain, install 8-inch-thick masonry plug in pipe end prior to backfill in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

G. Labeling of Asbestos Cement (AC) Pipe:

1. Label leak-tight container with warning statement of hazardous asbestos content in accordance with OSHA 29 CFR 1926.1101 and as noted below.

2. Label waste material with following warning:

DANGER
CONTAINS ASBESTOS FIBERS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
DO NOT BREATHE DUST
AVOID CREATING DUST

3. Neatly print labels in letters of sufficient size and contrast so label is easily visible and legible.

3.4 BACKFILL

A. Backfill of removal areas shall be in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

3.5 DISPOSAL

A. Inlet frames, grates, and plates; and manhole frames and covers, may remain City property. Disposal shall be in accordance with requirements of Section 01576 - Waste Material Disposal.

B. Remove from site, debris resulting from work under this section in accordance with requirements of Section 01576 - Waste Material Disposal.

C. For asbestos-containing materials:

1. Comply with 40 CFR Part 61 and 30 TAC Sections 330.137(b) for Industrial Class 1 waste.

2. Inspect load to ensure correct packaging and labeling.

3. Line vehicles with two layers of 6-mil polyethylene sheeting.

4. Remove asbestos-containing waste from site daily.

END OF SECTION

Section 02316

EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavation, backfilling, and compaction of backfill for structures.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for structural excavation and backfill under this Section. Include payment in lump sum price.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 DEFINITIONS

A. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.

2. Materials that cannot be compacted to the required density due to either gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.

C. Select Material: Material as defined in Section 02320 - Utility Backfill Materials.

D. Backfill: Select material meeting specified quality requirements, placed and compacted under controlled conditions around structures.

E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material

separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

F. Foundation Base: For foundation base material, use crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level working surface for the construction of the concrete foundation.

G. Foundation Subgrade: Foundation subgrade is the surface of the natural soil which has been excavated and prepared to support the foundation base or foundation backfill, where needed.

H. Ground Water Control Systems: Installations external to the excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower the ground water, intercepting seepage which would otherwise emerge from the side or bottom of the excavation, and depressurization to prevent failure or heaving of the excavation bottom. Refer to Section 01578 - Control of Ground Water and Surface Water.

I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from the excavation. Remove rain water and surface water which accidentally enters the excavation as a part of excavation drainage.

J. Excavation Drainage: Removal of surface and seepage water in the excavation by sump pumping and using French drains surrounding the foundation to intercept the water.

K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below the foundation as shown on Drawings, and backfilled with foundation backfill material.

L. Shoring System: A structure that supports the sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.04 REFERENCES

A. ASTM D 558 - Test Methods for Moisture-Density Relations of Soil Cement Mixtures.

B. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.88-mm) Drop.

C. ASTM D 1556 - Density of Soil in Place by the Sand-Cone Method.

D. ASTM D 2487 - Classification of Soils for Engineering Purposes.

E. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

F. ASTM D 3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).

G. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

H. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.

I. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

J. Federal Regulations, 29 CFR, Part 1926, Standards - Excavation, Occupational Safety and Health Administration (OSHA).

1.05 SUBMITTALS

A. Conform to requirements of Section 01300 - Submittal Procedures.

B. Submit a work plan for excavation and backfill for each structure with complete written description which identifies details of the proposed method of construction and the sequence of operations for construction relative to excavation and backfill activities. The descriptions, with supporting illustrations, shall be sufficiently detailed to demonstrate to the Engineer that the procedures meet the requirements of the Specifications and Drawings.

C. Submit excavation safety system plan.

1. The excavation safety system plan shall be in accordance with applicable OSHA requirements for all excavations.

2. The excavation safety system plan shall be in accordance with the requirements of Section 01561 - Trench Safety System, for all excavations that fall under State and Federal trench safety laws.

D. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 01578 - Control of Ground Water and Surface Water.

E. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.

F. Submit project record documents under provisions of Section 01785 - Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.06 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the District in

accordance with requirements of Section 01454 - Testing Laboratory Services and as specified in this Section.

B. Contractor shall perform embedment and backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Perform excavation with equipment suitable for achieving the requirements of this Specification.

B. Use equipment which will produce the degree of compaction specified. Backfill within 3 feet of walls shall be compacted with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to the depth of the fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

2.02 MATERIAL CLASSIFICATIONS

A. Backfill materials shall conform to the classifications and product descriptions of Section 02320 - Utility Backfill Materials. The classification or product description for backfill applications shall be as shown on the Drawings and as specified.

PART 3 EXECUTION

3.01 PREPARATION

A. Conduct an inspection to determine condition of existing structures and other permanent installations.

B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where affected by the Work, and is considered hazardous to traffic movements.

C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 01561 - Trench Safety Systems.

D. Remove existing pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02221 - Removing Existing Pavements and Structures.

E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01578 - Control of Ground Water and Surface Water.

3.02 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01562 - Tree and Plant Protection.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on the Drawings.

D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.

E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to the District.

3.03 EXCAVATION

A. Perform excavation work so that the underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to the absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Engineer.

B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Engineer and obtain instructions before proceeding in such areas.

C. Immediately notify the agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Engineer and agency for any repairs or relocations, either temporary or permanent.

D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.

E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.

F. Conduct hauling operations so that trucks and other vehicles do not create a dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.

G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by the Work.

H. Provide sheeting, shoring, and bracing where required to safely complete the Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect the Work and adjacent structures or improvements. Sheeting, shoring, and bracing used to protect workmen and the public shall conform to requirements of Section 02260 - Trench Safety Systems.

I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, concrete fill, cement stabilized sand, or other material approved by Engineer.

J. After completion of the structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by Engineer in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to the Work and adjacent structures or improvements.

K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or material approved by Engineer.

3.04 HANDLING EXCAVATED MATERIALS

A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at a sufficient distance from excavation to prevent slides or cave-ins.

B. Provide additional backfill material in accordance with requirements of Section 02319 - Borrow, if adequate quantities of suitable material are not available from excavation and trenching operations at the site.

3.05 DEWATERING

A. Provide ground water control per Section 01578 - Control of Ground Water and Surface Water.

B. Keep ground water surface elevation a minimum of 2 feet below the bottom of the foundation base.

C. Maintain ground water control as directed by Section 01578 - Control of Ground Water and Surface Water and until the structure is sufficiently complete to provide the required weight to resist hydrostatic uplift with a minimum safety factor of 1.2.

3.06 FOUNDATION EXCAVATION

A. Notify Engineer at least 48 hours prior to planned completion of foundation excavations. Do not place the foundation base until the excavation is accepted by the Engineer.

B. Excavate to elevations shown on Drawings, as needed to provide space for the foundation base, forming a level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or a material as directed by the Engineer. Prior to placing material over it, recompact the subgrade where indicated on the Drawings, scarifying as needed, to 95 percent of the maximum Standard Dry Density according to ASTM D 698. If the specified level of compaction cannot be achieved, moisture condition the subgrade and recompact until 95 percent is achieved, over-excavate to provide a minimum layer of 24 inches of foundation backfill material, or other means acceptable to the Engineer.

C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by the Engineer.

D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in a satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.

E. Soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to the required subgrade, shall be removed and replaced with foundation backfill material, as directed by Engineer, at no additional cost to the District.

F. Place foundation base, or foundation backfill material where needed, over the subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with a seal slab or cement-stabilized sand.

G. Crushed aggregate, and other free draining Class I materials, shall have a filter fabric as specified in Section 02621 - Geotextile, separating it from native soils or select material backfill. The fabric shall overlap a minimum of 12 inches beyond where another material stops contact with the soil.

H. Crushed aggregate, and other Class I materials, shall be placed in uniform layers of 8-inch maximum thickness. Compaction shall be by means of at least two passes of a vibratory compactor.

3.07 FOUNDATION BASE

A. After the subgrade is properly prepared, including the placement of foundation backfill where needed, the foundation base shall be placed. The foundation base shall consist of a 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, a seal slab with a minimum thickness of 4 inches may be placed. The foundation base shall extend a minimum of 12 inches beyond the edge of the structure foundation, unless shown otherwise on the Drawings.

B. Where the foundation base and foundation backfill are of the same material, both can be placed in one operation.

3.08 BACKFILL

A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Use existing material that qualifies as select material, unless indicated otherwise. Deposit backfill in uniform layers and compact each layer as specified.

B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that the concrete has reached a minimum of 85 percent of the specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until the slab or intermediate walls have been placed and concrete has attained sufficient strength.

C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.

D. Maintain fill material at no less than 2 percent below nor more than 2 percent above optimum moisture content. Place fill material in uniform 8-inch maximum loose layers. Compaction of fill shall be to at least 95 percent of the maximum Standard Dry Density according to ASTM D 698 under paved areas. Compact to at least 90 percent around structures below unpaved areas.

E. Where backfill is placed against a sloped excavation surface, run compaction equipment across the boundary of the cut slope and backfill to form a compacted slope surface for placement of the next layer of backfill.

F. Place backfill using cement stabilized sand in accordance with Section 02321 - Cement Stabilized Sand.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.

B. Tests will be performed initially on minimum of one different sample of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.

C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions:

1. A minimum of one test for every 100 cubic yards of compacted backfill material.

2. A minimum of three density tests for each full work shift.

3. Density tests will be performed in all placement areas.

4. The number of tests will be increased if inspection determines that soil types or moisture contents are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density.

D. At least one test for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.

E. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.10 DISPOSAL OF EXCESS MATERIAL

Dispose of excess materials in accordance with requirements of Section 01576 - Waste Material Disposal.

END OF SECTION

Section 02317

EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No additional payment will be made for trench excavation, embedment and backfill under this Section. Include cost in the lump sum price.

2. No separate or additional payment will be made for surface water control, ground water control, or for excavation drainage.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at the trench subgrade after excavation to depth of bottom of the bedding as shown on the Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: The portion of trench backfill that extends vertically from top of foundation up to a level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: The material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

D. Initial Backfill: The portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to a level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. Pipe Embedment: The portion of trench backfill that consists of bedding, haunching and initial backfill.

F. Trench Zone: The portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.

2. Materials that cannot be compacted to required density due to either gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

H. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement are considered suitable, unless otherwise indicated.

I. Backfill: Suitable material meeting specified quality requirements, placed and compacted under controlled conditions.

J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01578 - Control of Ground Water and Surface Water.

K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as a part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using a drainage layer, as defined in ASTM D 2321, placed on the foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regard to the stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as a result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.

2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.

a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.

b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in the embedment zone in combination with ground water control in predominately sandy or silty soils.

3. Unstable Trench: Unstable trench conditions exist in the pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

N. Subtrench: Subtrench is a special case of benched excavation. Subtrench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of a subtrench depends upon trench stability and safety as determined by the Contractor.

O. Trench Dam: A placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along the trench.

P. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.

Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

R. Trench Safety Systems include both protective systems and shoring systems as defined in Section 02260 - Trench Safety Systems.

S. Trench Shield (Trench Box): A portable worker safety structure moved along the trench as work proceeds, used as a protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within the trench. Trench shields may be stacked if so designed or placed in a series depending on depth and length of excavation to be protected.

T. Shoring System: A structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of the ground affecting adjacent installations or improvements.

U. Special Shoring: A shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on the Drawings.

1.04 REFERENCES

A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.

B. ASTM D 558 - Test Methods for Moisture-Density Relations of Soil Cement Mixtures.

C. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.

D. ASTM D 1556 - Test Method for Density in Place by the Sand-Cone Method.

E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

F. ASTM D 2487 - Classification of Soils for Engineering Purposes.

G. ASTM D 2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 3017 - Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

I. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.

K. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.05 SCHEDULING

A. Schedule work so that pipe embedment can be completed on the same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.06 SUBMITTALS

A. Conform to Section 01300 - Submittal Procedures.

B. Submit a written description for information only of the planned typical method of excavation, backfill placement and compaction, including:

1. Sequence of work and coordination of activities.

2. Selected trench widths.

3. Procedures for foundation and embedment placement, and compaction.

4. Procedure for use of trench boxes and other premanufactured systems while assuring specified compaction against undisturbed soil.

5. Procedure for installation of Special Shoring at locations identified on the Drawings.

C. Submit a ground and surface water control plan in accordance with requirements in this Section and Section 01578 - Control of Ground Water and Surface Water.

D. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.

E. Submit a trench excavation safety program in accordance with requirements of Section 01561 - Trench Safety System. Include designs for special shoring meeting the requirements defined in Paragraph 1.08, Special Shoring Design Requirements.

F. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

1.07 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the City in accordance with requirements of Section 01454 - Testing Laboratory Services and as specified in this Section.

B. Perform backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

1.08 SPECIAL SHORING DESIGN REQUIREMENTS

A. Have special shoring designed or selected by the Contractor's Professional Engineer to provide support for the sides of the excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a premanufactured system selected by the Contractor=s Professional Engineer to meet the project site requirements based on the manufacturer=s standard design.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving the requirements of this Section.

B. Use only hand-operated tamping equipment until a minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.09, Shoring Design Requirements.

2.02 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 02320 - Utility Backfill Materials.

B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Section 03315 - Concrete for Utility Construction.

C. Geotextile (Filter Fabric): Conform to requirements of Section 02621- Geotextile.

D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

E. Timber Shoring Left in Place: Untreated oak.

PART 3 E X E C U T I O N

3.01 STANDARD PRACTICE

A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.

B. Install rigid pipe to conform with standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between the standard practice and the requirements of this Section, this Section governs.

3.02 PREPARATION

A. Establish traffic control to conform with requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections affected by the Work, and is considered hazardous to traffic movements.

B. Perform work to conform with applicable safety standards and regulations. Employ a trench safety system as specified in Section 01561 - Trench Safety Systems.

C. Immediately notify the agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from the City Engineer and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, to conform with requirements of Section 02221 - Removing Existing Pavements and Structures, as applicable.

E. Install and operate necessary dewatering and surface water control measures to conform with Section 01578 - Control of Ground Water and Surface Water.

F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Section 01725 - Field Surveying.

3.03 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within the grading limits as designated on the Drawings, and in accordance with requirements of Section 01562 - Tree and Plant Protection.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities are indicated on the Drawings.

D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to City.

3.04 EXCAVATION

A. Except as otherwise specified or shown on the Drawings, install underground utilities in open cut trenches with vertical sides.

B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on the Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

C. Determine trench excavation widths using the following schedule as related to pipe outside diameter (O.D.). Maximum trench width shall be the minimum trench width plus 24 inches.

Nominal Pipe Size, Inches	Minimum Trench Width, Inches
Less than 18	O.D. + 18
18 to 30	O.D. + 24
Greater than 30	O.D. + 36

D. Use sufficient trench width or benches above the embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from the surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify the City Engineer and obtain instructions before proceeding.

F. Shoring of Trench Walls.

1. Install Special Shoring in advance of trench excavation or simultaneously with the trench excavation, so that the soils within the full height of the trench excavation walls will remain laterally supported at all times.

2. For all types of shoring, support trench walls in the pipe embedment zone throughout the installation. Provide trench wall supports sufficiently tight to prevent washing the trench wall soil out from behind the trench wall support.

3. Unless otherwise directed by the City Engineer, leave sheeting driven into or below the pipe embedment zone in place to preclude loss of support of foundation and embedment materials. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and the trench wall in the vicinity of the pipe zone.

4. Employ special methods for maintaining the integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.

5. If sheeting or other shoring is used below top of the pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into the embedment zone shall be the equivalent of a 1-inch-thick steel plate. Fill voids left on removal of supports with compacted backfill material.

G. Use of Trench Shields. When a trench shield (trench box) is used as a worker safety device, the following requirements apply:

1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to the trench sidewalls.

2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor the degree of compaction reduced.

3. When required, place, spread, and compact pipe foundation and bedding materials beneath the shield. For backfill above bedding, lift the shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.

4. Maintain trench shield in position to allow sampling and testing to be performed in a safe manner.

3.05 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials which are suitable as defined in this Section and conforming with Section 02320 - Utility Backfill Materials. Place material suitable for backfilling in stockpiles at a distance from the trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming with requirements of Section 02320 - Utility Backfill Materials.

C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect excess stockpiles for use on site. Maintain site conditions in accordance with Section 01504 - Temporary Facilities and Controls.

3.06 GROUND WATER CONTROL

A. Implement ground water control according to Section 01578 - Control of Ground Water and Surface Water. Provide a stable trench to allow installation in accordance with the Specifications.

3.07 TRENCH FOUNDATION

A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

B. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.08 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

A. Immediately prior to placement of embedment materials, the bottoms and sidewalls of trenches shall be free of loose, sloughing, caving, or otherwise unsuitable soil.

B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.

C. For pipe installation, manually spread embedment materials around the pipe to provide uniform bearing and side support when compacted. Do not allow materials to free-fall

from heights greater than 24 inches above top of pipe. Perform placement and compaction directly against the undisturbed soils in the trench sidewalls, or against sheeting which is to remain in place.

D. Do not place trench shields or shoring within height of the embedment zone unless means to maintain the density of compacted embedment material are used. If moveable supports are used in embedment zone, lift the supports incrementally to allow placement and compaction of the material against undisturbed soil.

E. Place geotextile to prevent particle migration from the in-situ soil into open-graded (Class I) embedment materials or drainage layers.

F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

G. Place haunching material manually around the pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside the pipe with sand bags or other suitable means.

H. Place electrical conduit, if used, directly on foundation without bedding.

I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.

J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Section 02320 - Utility Backfill Material. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:

1. Class I, II, and III Embedment Materials:

   a. Maximum 6 inches compacted lift thickness.

   b. Compact to achieve a minimum of 95 percent of maximum dry density as determined according to ASTM D 698.

   c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by City Engineer.

2. Cement Stabilized Sand:

   a. Maximum 6 inches compacted thickness.

b. Compact to achieve a minimum of 95 percent of maximum dry density as determined according to ASTM D 698.

c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.

3. Class I embedment materials.

a. Maximum 6-inches compacted lift thickness.

b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed the pipe to meet the deflection test criteria.

c. Moisture content as determined by Contractor for effective compaction without softening the soil of trench bottom, foundation or trench walls.

4. Class II embedment and cement stabilized sand.

a. Maximum 6-inches compacted thickness.

b. Compaction by methods determined by Contractor to achieve a minimum of 95 percent of the maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.

c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on the dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.

K. Place trench dams in Class I embedments in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.09 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only the minimum length of trench open as necessary for construction.

B. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave the sheeting in place. Cut off sheeting 1.5 feet or more above the crown of the pipe. Remove trench supports within 5 feet from the ground surface.

C. For sewer pipes, use backfill materials described here as determined by trench limits. As trench zone backfill in paved areas for streets and to one foot back of curbs and pavements, use cement stabilized sand for pipe of nominal sizes less than 36 inches.

Uniformly backfill trenches partially within limits one foot from streets and curbs according to the paved area criteria. Use select backfill within one foot below pavement subgrade for rigid pavement. For asphalt concrete, use flexible base material within one foot below pavement subgrade.

D. For water lines, backfill in trench zone, including auger pits, with bank run sand, select fill, or random backfill material as specified in Section 02320 - Utility Backfill materials.

E. When shown on Drawings, a random backfill of suitable material may be used in trench zone for trench excavations outside pavements.

F. Place trench zone backfill in lifts and compact by methods selected by the Contractor. Fully compact each lift before placement of the next lift.

1. Bank run sand.

   a. Maximum 9-inches compacted lift thickness.

   b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.

   c. Moisture content within 3 percent of optimum determined according to ASTM D 698

2. Cement-stabilized sand.

   a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but not exceeding 24 inches.

   b. Compaction by vibratory equipment to a minimum of 95 percent of the maximum dry density determined according to ASTM D 558.

   c. Moisture content on the dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.

3. Select fill.

   a. Maximum 6-inches compacted thickness.

   b. Compaction by equipment providing tamping or kneading impact to a minimum of 95 percent of the maximum dry density determined according to ASTM D 698.

   c. Moisture content within 2 percent of optimum determined according to ASTM D 698.

G. For trench excavations outside pavements, a random backfill of suitable material may be used in the trench zone.

1. Fat clays (CH) may be used as trench zone backfill outside paved areas at the Contractor=s option. If the required density is not achieved, the Contractor, at his option and at no additional cost to the City, may use lime stabilization to achieve compaction requirements or use a different suitable material.

2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.

3. Compact to a minimum of 90 percent of the maximum dry density determined according to ASTM D 698.

4. Moisture content as necessary to achieve density.

H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, JUNCTION BOXES, AND OTHER PIPELINE STRUCTURES

A. Meet the requirements of adjoining utility installations for backfill of pipeline structures, as shown on the Drawings.

3.11 FIELD QUALITY CONTROL

A. Test for material source qualifications as defined in Section 02320 - Utility Backfill Materials.

B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to City.

C. Tests will be performed on a minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is a noticeable change in material gradation or plasticity.

D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Additional moisture-density relationship tests will be performed whenever there is a noticeable change in material gradation or plasticity.

E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at the following frequencies and conditions.

1. A minimum of one test for every 20 cubic yards of compacted embedment and for every 50 cubic yards of compacted trench zone backfill material.

2. A minimum of three density tests for each full shift of Work.

3. Density tests will be distributed among the placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.

4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.

5. Density tests may be performed at various depths below the fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.

6. Two verification tests will be performed adjacent to in-place tests showing density less than the acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.

7. Recompacted placement will be retested at the same frequency as the first test series, including verification tests.

F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.

G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Section 01576 - Waste Material Disposal

END OF SECTION

Section 02501

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ductile iron pipe and fittings for water lines, wastewater force mains, gravity sanitary sewers, and storm sewers.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for ductile iron pipe and fittings under this Section. Include cost in schedule of values for work as specified in the following Sections, as applicable:

   a. Section 15180 – Process Air Piping
   b. Section 02531 – Gravity Sanitary Sewers
   c. Section 02532 – Sanitary Sewer Force Mains

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.

B. ANSI A 21.10 (AWWA C 110) - Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.

C. ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

D. ANSI A 21.15 (AWWA C 115) - Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

E. ANSI A21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.

F. ANSI A 21.50 (AWWA C 150) - Standard for Thickness Design of Ductile-Iron Pipe.

G. ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.

H. ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.

I. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

J. ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.

K. ASTM F 477 - Elastomeric Seals (gaskets) for Joining Plastic Pipe.

L. ASTM G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.

M. AWWA C 102 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

N. AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.

O. AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

P. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.

Q. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.

R. American Association of State Highway Transportation Officials (AASHTO).

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. For pipes 16 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:

1. Manufacturer's pipe design calculations.

2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Project Manager. Provide final approved lay schedule

3. Calculations and limits of thrust restraint. 4. Class and length of joint.

C. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.

D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11. E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

PART 2 PRODUCTS

For approved manufacturers see Appendix for City of Seabrook Approved Products List.

2.01 DUCTILE IRON PIPE

A. Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water lines and thickness Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

C. Modify pipe for cathodic protection in accordance with Section 16640 - Cathodic Protection for Pipelines. In lieu of furnishing ductile iron pipe with cathodic protection system, furnish ductile iron pipe with polyethylene encasement, provided the following criteria is met:

1. Provide minimum thickness class.

2. Provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.

3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.05 D.1.

4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).

D. For use of pressure class pipe for water lines, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREMA E-80 loads and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for a transition width trench for zero to 16 feet of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston's equations for a trench condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:

1. Working pressure = 100 psi.

2. Hydrostatic field test pressure = 150 psi.

3. Maximum pressure due to surge = 150 psi.

4. Minimum Pressure due to surge = -5 psi.

5. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.

6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.

7. Unit weight of fill ≥120 pcf.

8. Deflection lag factor (D_l) = 1.2.

9. Bedding constant (K) = 0.1.

10. Moment coefficient = 0.16.

11. Fully saturated soil conditions hw=h=depth of cover above top of pipe.

E. Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.

F. Pipe Manufacturer for large diameter water lines: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

Line Diameter	Required Bends*
20 and 24 inches	Four 45° bends per 5,000 LF of water line
> 24 inches	Four 22.5° bends per 10,000 LF of water line
*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e. two 22.5° bends are equivalent to one 45° bend) and will be counted as one fitting.	

Manufacturer or supplier must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Project Manager where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.

G. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Project Manager.

H. Clearly mark pipe section to show location and thickness/pressure class color coded.

2.02 JOINTS

A. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.

B. Where required by Drawings, provide approved restrained joints for buried service.

C. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.

D. Provide for restrained joints designed to meet test pressures required under Section 02515 - Hydrostatic Testing of Pipelines or Section 02532 - Sanitary Sewer Force Mains, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.

E. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Project Manager. When other methods are deemed satisfactory, install at no additional cost to City.

2.03 GASKETS

A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

B. For pipes to be installed in potentially contaminated areas, see Specification Section 02105 - Sampling and Analysis in PPCA.

2.04 FITTINGS

A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.

B. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.

E. Ductile Iron Compact Fittings for Water lines: ANSI A 21.53; 4 inch through 12 inch diameter fusion bonded epoxy-lined or cement mortar lining.

2.05 COATINGS AND LININGS

A. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A 21.16 fusion bonded epoxy coating for interior; comply with NSF 61.

B. Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.

2. Liner thickness: Nominal 40 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.

3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.

4. Acceptable Lining Materials:

a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.

b. Ceramic Epoxy - Protecto 401.

C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.

D. Exterior:

1. Water Lines

a. Auger Holes: Conform to requirements of Section 02527 - Polyurethane Coatings on Steel or Ductile Iron Pipe.

b. Above Ground (or Exposed): Conform to requirements of Section 02502 - Steel Pipe and Fittings, Paragraph 2.03.

c. Tunnel, Casing or Direct Bury: Conform to requirements of Paragraph 2.05E.

2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

E. Polyethylene Wrap: For buried pipes not cathodically protected, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Section 02528 - Polyethylene Wrap.

F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report.

H. For water lines cathodically protected, supply ductile iron pipe with either tape coatings or some other bonded dielectric coating as specified in Section 02518 - Steel Pipe and Fittings for Large Diameter Water Lines.

2.06 MANUFACTURERS

A. Pre-Approved manufacturers include:
   1. Griffin Pipe Products, Inc.
   2. American Cast Iron Pipe Co.
   3. US Pipe

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to installation requirements of Sections 15180-Process Air Piping, 02531 – Gravity Sanitary Sewers, and 02532 – Sanitary Sewer Force Mains.

B. Install in accordance with AWWA C 600 and manufacturer's recommendations.

C. Install all ductile iron pipe in double polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.

D. Holiday Testing.

   1. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

3.02 FIELD REPAIR OF COATINGS

A. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION

Section 02502

STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel pipe and fittings for water lines for aerial crossings, aboveground piping, and encasement sleeves. Do not bury steel pipe, unless it is large diameter water line.

B. Specifications identify requirements for small-diameter less than or equal to 20 inches.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for steel pipe and fittings under this Section. Refer to Section 02511 - Water Lines for measurement and payment.

2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AASHTO - Standard Specifications for Highway Bridges.

B. ASME B 16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

C. ASTM A 36 - Standard Specification for Carbon Structural Steel.

D. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

E. ASTM A 105 - Standard Specification for Carbon Steel Pipe Forgings for Piping Applications

F. ASTM A 106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

G. ASTM A 135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.

H. ASTM A 139 - Standard Specification for Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over).

I. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

J. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

K. AWWA C 200 - Standard for Steel Water Pipe 6 in. and Larger.

L. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

M. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.

N. AWWA C 210 - Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

O. AWWA C 604 – Installation of Buried Steel Water Pipe – 4 In. and Larger.

P. AWWA M 11 – Steel Pipe – A Guide for Design and Installation.

O. SSPC Good Painting Practice, Volume 1.

P. SSPC SP 1 - Surface Preparation Specification No. 1 Solvent Cleaning.

Q. SSPC SP 5 - Joint Surface Preparation Standard White Blast Cleaning.

R. SSPC SP 6 - Surface Preparation Specification No. 6 Commercial Blast Cleaning.

S. SSPC SP 10 - Surface Preparation Specification No. 10 Near-White Blast Cleaning.

T. SSPC VIS 1 - Visual Standard for Abrasive Blast Cleaned Steel.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures. For aerial crossings and above ground piping, include lay schedule of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings.

B. Submit manufacturer's certifications that pipe and fittings are new and unused.

C. Submit manufacturer's certifications that pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C 200.

D. Submit manufacturer's affidavits that coatings and linings comply with applicable requirements of this Section and:

1. Polyurethane coatings were applied in strict accordance with manufacturer's recommendation and allowed to cure at temperature 5 degrees above dewpoint.

2. Linings were applied and allowed to cure at temperature above 32 F.

E. Submit certification from NACE Certified Coatings Inspector, having Level III certification for coatings and linings, that steel pipe furnished on project was properly inspected and defective coatings detected were properly repaired.

1.5 QUALITY CONTROL

A. Prior to start of work, provide proof of certification of qualification for welders employed for type of work, procedures and positions involved. Provide welder qualifications in accordance with AWWA C 206.

B. Shop-applied coatings and linings; provide services of an independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Perform inspection by NACE trained inspectors under supervision of NACE Level III Certified Coatings Inspector verifying compliance with same requirements specified in Paragraph 3.02.

C. Coatings: Measure temperature and dew point of ambient air before applying coatings. Inspect physical dimensions and overall condition of coatings. Inspect for visible surface defects, thickness, and adhesion of coating to surface and betweenlayers.

D. Final Inspection:

1. Before shipment, inspect each finished pipe, fitting, special and accessory for markings, metal thickness, coating thickness, lining thickness (if shop applied), joint dimensions, and roundness.

2. Inspect for coating placement and defects. Test exterior coating for holidays.

a. Inspect linings for thickness, pitting, scarring, and adhesion.

E. Ensure workmen engaged in manufacturing are qualified and experienced in performanceof their specific duties.

PART 2 PRODUCTS

2.1 STEEL PIPE

A. Provide steel pipe and encasement sleeves designed and manufactured in conformance with AWWA C 200 and AWWA M 11 except as modified herein. Steel to be minimum of ASTM A106, ASTM A 36, ASTM A 1011 Grade 36, ASTM A 53 Grade B, ASTM A 135 Grade B, or ASTM A 139 Grade B.

B. Minimum Allowable Steel-Wall Thickness:

CARRIER PIPE			
Nom. Pipe Size	Min. Wall		Approx. Wt. Per L. F. Uncoated
	O.D (In.)	Thick. (In.)	
4	4.50	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.75	0.365	40.48
12	12.75	0.375	49.56
16	16.00	0.375	62.58
20	20.00	0.375	78.60

Notes for Carrier Pipe:

1. Review pipe and fitting design for conditions exceeding those specified herein.

2. Provide pipe with wall thickness of no less than listed in table above.

MINIMUM DIAMETER CASING PIPE (ENCASEMENT SLEEVES)			
Corresp. Casing Pipe Size (In.)	Min. Wall		Approx. Wt. Per L. F. Uncoated
	O.D. (In.)	Thick. (In.)	
8	8.625	0.219	19.64
10	10.75	0.219	24.60
12	12.75	0.219	29.28
16	16.00	0.219	36.86
18	18.00	0.25	47.39
20	20.00	0.250	52.73

24	24.00	0.250	63.41

Notes for Casing Pipe:

1. Provide casing pipe with wall thickness of no less than listed in table above.

2. Casing pipe: AWWA C 200 new uncoated welded steel.

3. Verify casing diameter required with dimensions of casing spacer.

C. Provide pipe sections in lengths of no less than 16 feet except as required for special sections, and no greater than 40 feet.

D. Provide short sections of steel pipe no less than 4 feet in length unless indicated on Drawings or specifically permitted by Project Manager.

E. Fittings: Factory forged for sizes 4 inches through 20 inches; long radius bends; beveled ends for field butt welding; wall thickness equal to or greater than pipe to which fitting is to be welded unless otherwise shown on Drawings.

F. Joints:

1. Standard field joint for steel pipe and encasement sleeve: AWWA C 206. Single- welded, butt joint.

2. Electrically isolate flanged joints between steel and cast iron by using flange isolation fittings as specified in paragraph 2.03 of Specification Section 15640 – Joint Bonding and Electrical Isolation. Use epoxy coated nuts and bolts to assemble the fittings.

3. Elbows to be standard weight seamless elbows per ASTM A106, Grade A or B.

G. Flanges: Refer to Specification Section 02511 – Water Lines.

2.2 INTERNAL LINING SYSTEMS FOR STEEL PIPE, ALL INSTALLATIONS

A. Supply steel pipe with epoxy lining, capable of conveying water at temperatures not greater than 140 degrees F. Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certification to be from organization accredited by ANSI. Unless otherwise noted, coat exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified.

B. Epoxy Lining AWWA C 210, White, or approved equal for shop and field applied, except as modified in this Section. Provide material from same manufacturer.

Surface Preparation as recommended by manufacturer	SSPC-10 Near White Blast Clean
Finish Coat	AWWA C210. Provide Devoe Bar Rust 233H or approved equal.

1. Provide dry film thickness in accordance with product manufacturer recommendations. Do not exceed maximum DFT as recommended by manufacturer.

2. Factory Testing: In accordance with AWWA C210.

2.3 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND AND IN VAULTS (EXPOSED)

A. Provide approved epoxy/polyurethane coating system as designated below. Provide material from same manufacturer.

Surface Preparation as recommended by manufacturer	SSPC SP 10 Near White Blast Clean
Intermediate Coat	Chemical Resistant Epoxy, or approved equal, AWWA C210
Finish Coat	Polyurethane, or approved equal Blue Fed Std. No. 15102 color as approved by Project Manager

B. Total Allowable Dry Film Thickness (DFT) for System: as recommended by manufacturer.

C. Factory and field testing: in accordance with AWWAC210.

D. Clean bare pipe free from mud, mill lacquer, oil, grease, or other contaminant. Inspect and clean surfaces according to SSPC-SP-1 to remove oil, grease, and loosely adhering deposits prior to blast cleaning. Remove visible oil and grease spots by solvent wiping. Use only approved safety solvents which do not leave residue. Use preheating to remove oil, grease, mill scale, water, and ice provided pipe is preheated in uniform manner to avoid distortion.

E. Remove surface imperfections such as slivers, scabs, burrs, weld spatter, and gouges. Grind weld bead for proper coating application as recommended by coating manufacturer. Presence of metallic defects may be cause for rejection of pipe.

PART 3 EXECUTION

3.1 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02511 - Water lines, except as modified in this Section.

B. Comply with the following:

1. Bedding and Backfilling: Conform to requirements of Section 02317 - Excavation and Backfill for Utilities.

2. For pipes with coating: Do not roll or drag pipe on ground, move pipe in such a manner as not to damage pipe or coating. Carefully inspect pipe for abrasions andrepair damaged coating before pipe is installed.

C. Static Electricity:

1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.

2. Electrically test where required after installation is complete.

3.2 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVE GROUND AND IN VAULTS (EXPOSED) AND EPOXY INTERNAL LINING SYSTEM.

A. Safety: Paints, coatings, and linings specified in this Section are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for personnel involved in painting, coating, and lining operations.

B. Workmanship:

1. Application: By qualified and experienced workers who are knowledgeable insurface preparation and application of high-performance industrial coatings.

2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.

C. Surface Preparation:

1. Prepare surfaces for painting by using abrasive blasting.

2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly-painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.

3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP 1.

4. Metal and Weld Preparation: Remove surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimumradius.

5. Abrasive Material:

   a. Blast only as much steel as can be coated same day of blasting.

   b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to job site in moisture-proof bags or airtight bulk containers. Copper slag abrasives are notacceptable.

   c. After abrasive blast cleaning, verify surface profile with replica tape suchas Tes-Tex Coarse or Extra Coarse Press-O-Film Tape, or approved equal. Furnish tapes to Project Manager.

   d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.

6. Evaluate degree of cleanliness for surface preparation with use of SSPC Pictorial Surface Preparation Standards for Painting Steel Surfaces, SSPC-Vis 1.

7. Remove dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air. Test cleanliness by placing ¾-inch by-4 inch piece of clear Scotch type tape on blasted surface, then removing and placing tape on 3x5 white index card. Reclean areas exhibiting dust or residue.

D. Coating and Lining Application:

1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application; or when relative humidity isabove 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. Provide dehumidifiers for field-applied coatings and linings to maintain proper humidity levels.

2. Application Procedures:

   a. Apply in accordance with manufacturer's recommendations and requirements of this Section. Provide finish free of runs, sags, curtains,

pinholes, orange peel, fish eyes, excessive over spray, or delaminations.

b. Thin materials only with manufacturers recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.

c. Discard catalyzed materials remaining at end of day.

3. Thoroughly dry pipe before primer is applied. Apply primer immediately after cleaning surface. Apply succeeding coats before contamination of undersurface occurs.

4. Cure a minimum of 24 hours at 77 degrees F before successive coats are applied. During curing process, provide force air ventilation in volume sufficient to maintain solvent vapor levels below published threshold limit value. Apply successive coats within recoat threshold time as recommended by coating or lining manufactureron printed technical data sheets or through written communications. Brush blast joints of pipe which have been shop primed and are to receive intermediate and finish coats in field prior to application of additional coats. After interior coatings are applied, provide forced air ventilation in sufficient volume and for sufficient length of time to ensure proper curing before filling pipe with water.

E. Testing of Coatings and Linings:

1. Inspect pipe for holidays and damage to coating:

a. If test indicates no holidays and coating is damaged, remove damaged layers of coating and repair in accordance with coating manufacturer'srecommendations.

2. Perform holiday test in accordance with NACE Standard Recommended Practice, RPO 188-90, Discontinuity (Holiday) Testing of Protective Coatings.

3. Begin testing of completed coating after coating has sufficiently cured, usually one to 5 days. Consult coating manufacturer for specific curing schedule.

4. Perform adhesion test on pipe in accordance with ASTM D 4541.

5. For coating thickness of 20 mils or less, test with wet sponge low-voltage holiday detector. For coating thickness in excess of 20 mils, test with high-voltage holiday detector. Perform electrical holiday test with 60-cycle current audio detector. Select test voltage as suggested in table below.

MINIMUM VOLTAGES FOR
HIGH VOLTAGE SPARK

TESTING

Total Dry Film Thickness	Suggested Inspection
20 to 40	3,000
41 to 55	4,000
56 to 80	6,000

3.3 JOINTS AND JOINTING

A. Welded Joints:

1. Conform to requirements of Section 02511 - Water Lines.

2. Field weld to be full penetration butt welded joints for steel pipe andencasement sleeves for entire circumference.

3. City will employ an independent certified testing laboratory to perform weld acceptance tests on welded joints. Testing Laboratory will test by X-ray methods for butt welds, for 100 percent of joint welds. Project Manager has final decision as to suitability of welds tested.

B. Flanged Joints: Conform to requirements of Section 02511 - Water Lines.

3.4 COATINGS AND LININGS INSPECTION RESPONSIBILITIES

A. Contractor is responsible for quality control of coatings and linings applications and testing and inspection stipulated in this Section. Project Manager is responsible for quality assurance and reserves the right to inspect or acquire services of an independent third-party inspector who is fully knowledgeable and qualified to inspect surface preparation and application of high- performance coatings at all phases of coatings and linings work, field- or shop-applied. Contractor is responsible for proper application and performance of coatings and linings whether or not Project Manager provides such inspection.

END OF SECTION

Section 02506

POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.

B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 60 inches.

C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for PVC pipe under this Section. Include cost in unit price for work included as specified in the following sections:

   a. Section 02511 - Water Lines

   b. Section 02531 - Gravity Sanitary Sewers

   A. Section 02532 - Sanitary Sewer Force Mains

   B. Section 02631 - Storm Sewers

2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.

B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D. ASTM D 2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

E. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

F. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

G. ASTM 2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading

H. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

I. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

J. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

K. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

L. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

M. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

N. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

O. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

P. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.

Q. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.

R. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

S. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.

T. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.

U. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.

V. AWWA M23 – PVC Pipe – Design and Installation

W. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

X. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

C. Contractor to review and submit PVC pipe manufacturers recommended installation procedures.

D. Calculations and limits of thrust restraint shall be based on AWWA M23, latest edition.

1.5 QUALITY CONTROL

A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.

B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.

C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory

located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Project Manager for review. Cost of testing paid by Contractor.

PART 2 PRODUCTS

2.1 MATERIAL

A. For approved manufacturers see Appendix for City of Seabrook Approved Products List.

B. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.

C. Furnish PVC pressure pipe manufactured from Class 12454 virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

D. PVC Restrained Pipe: Must be listed on City's current Product Approval List.

1. Pipe Material:

a. DR 18: For restrained joints where shown on Drawings.

b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.

E. Water Service.

1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.

2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).

F. Gaskets:

1. Gasket materials shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.

2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.

3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

G. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

H. Do not use PVC in potentially or known contaminated areas.

I. Do not use PVC in areas exposed to direct sunlight.

2.2 WATER SERVICE PIPE

A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

B. Pipe 14 inch through 20 inch: AWWA C 905; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.

C. Provide Polyvinyl Chloride Pipe from approved manufacturers.

D. Make curves and bends by offsetting (i.e., deflecting joints). Do not exceed maximum offset recommended by pipe manufacturer or the City, whichever is less.

E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

2.3 GRAVITY SEWER PIPE

A. PVC gravity sanitary sewer pipe shall be in accordance with provisions in following table:

WALL CONSTRUCTION		ASTM DESIGNATION	SDR (MAX.)/ STIFFNESS (MIN.)	DIAMETER SIZE RANGE
Solid		D3034	SDR 26 / PS 115	6" to 10"
		D3034	SDR 35 / PS 46	12" & 15"
		F679	SDR 35 / PS 46	18" to 60"
		AWWA C900	DR 18 / N/A	4" to 12"
		AWWA C909	DR 18 / N/A	4" to 12"
		AWWA C905	DR 18 / N/A	14" to 20"

Note: Refer to City of Houston Approved Products List for list of manufacturers.

B. PVC storm sewer pipe shall be in accordance with provisions in following table:

WALL CONSTRUCTION	MANUFACTURER	ASTM DESIGNATION	SDR (MAX.)/ STIFFNESS (MIN.)	DIAMETER SIZE RANGE
Solid	J-M Pipe CertainTeed Diamond Uponor ETI North American	D3034	SDR 26 / PS 115	6" to 10"
		D3034	SDR 35 / PS 46	12" & 15"
		F679	SDR 35 / PS 46	18" to 27"
		AWWA C900	DR 18 / N/A	4" to 12"
		AWWA C909	DR 18 / N/A	4" to 12"
		AWWA C905	DR 18 / N/A	14" to 16"
Truss (Gasketed)	Contech	D2680	N/A /200 psi	8" to 15"
Profile	Contech A-2000	F949	N/A / 46 psi	12" to 36"
	Contech A-2026	F949	N/A / 115 psi	8" to 10"
	ETI, Ultra-Rib	F794	N/A / 46 psi	8" to 30"
	ETI, Ultra-Corr	F794	N/A / 46 psi	24" to 36"

C. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe stiffness of 115 psi.

D. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.

E. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded or otherwise held in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.

F. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

1. Fittings for straight through and transition connections conform to requirements of Section 02534- Sanitary Sewer Service Stubs or Reconnections.

G. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Project Manager. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified. This is a brief summary of the test method, and the full current edition of the standard must be followed.

H. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length. This is a brief summary of the test method, and the full current edition of the standard must be followed.

I. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.03F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test. This is a brief summary of the test method, and the full current edition of the standard must be followed.

J. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe. This is a brief summary of the test method, and the full current edition of the standard must be followed

K. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

L. Saddle for pipe with 0.5 inch width and greater: Connect side sewer by drilling proper size round hole in wall of the main sewer pipe, inserting an approved pipe compression saddle. The Saddle shall meet requirements of ASTM C-923. Saddles will accept 4", 6", and 8" pipe. The lateral pipe shall be held in place by one stainless steel compression band with stainless steel nut and bolt (any AISI Series 300) type tightening device and meeting requirements of ASTM A240. A stainless steel shear band shall wrap around the pipe a minimum of 380 degrees. Saddle may not protrude into mainline pipe.

2.4 SANITARY SEWER FORCE MAIN PIPE

A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Section 02532 - Sanitary Sewage Force Mains.

B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

C. Fittings: Provide approved ductile iron fittings as per Section 02501 - Ductile Iron Pipe and Fittings, Paragraph 2.04, except furnish fittings with one of following approved internal linings:

1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting

2. Nominal 40 mils (35 mils minimum) polyurethane

3. Nominal 40 mils (35 mils minimum) ceramic epoxy

4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy

D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Section 02528 - Polyethylene Wrap.

E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 200 psi, may be provided for up to 12 inches in diameter (water or sanitary).

B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

PART 3 EXECUTION

3.1 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

3.2 INSTALLATION

A. Conform to requirements of Section 02511 - Water Lines, Section 02531 - Gravity Sanitary Sewers, and Section 02532 - Sanitary Sewer Force Mains, as applicable.

B. Install PVC pipe in accordance with Section 02317 - Excavation and Backfill for Utilities, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.

C. Install PVC water service pipe to clear utility lines with minimum 6-inch separation, unless otherwise shown on Drawings:

D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.

E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support. Ensure barrel is fully supported along entire length of pipe, prior to backfilling.

F. For PVC pipe installed by trenchless methods, provide integral restrained joints and pull pipe through hole or casing. For PVC pipe pushed through hole or casing, provide approved bell insertion protection system.

G. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.

H. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

I. Pipe Assembly Procedures

1. Do not remove gasket from pipe.

2. Lay pipe by inserting spigot end into bell flush with the insertion line or as recommended by pipe manufacturer.

3. Do not assemble joint by swinging or stabbing.

4. Do not assemble joint using machinery or equipment such as backhoe bucket.

5. At no time shall spigot go past insertion line or homing mark. Continuously observe and check each homing mark for proper length, and install pipe with home mark visible.

3.3 PVC RESTRAINED MECHANISM

A. For low-profile coupling with spline-type joints:

1. Do not apply lubricant to spline or pipe or coupling spline grooves.

2. Do not use excessive force while inserting the spline through coupling.

3. Insert spline until it is fully seated around circumference of pipe.

B. Field Cutting of Pipe Ends:

1. Perform by workers certified by manufacturer.

2. Use a PVC pipe cutter and provide square ends.

3. Follow manufacturer's recommendation to disassemble restrained joint after it has been locked in place.

4. For low-profile coupling with spline-type joints, use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION

Section 02524

AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air release and vacuum relief valves.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for air release and vacuum relief valves is on unit price basis for each valve installed.

2. Payment includes manhole or vault (when required), fittings, vent piping and bollard(s) and appurtenances necessary for complete installation of valve.

3. Payment for valve assembly on aerial crossing includes fittings, anti-vandalism protection, freeze protection, vent piping and appurtenances necessary for complete installation of valve.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM A 48 - Standard Specification for Gray Iron Castings.

B. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

C. ASTM A 240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

D. ASTM A 276 - Standard Specification for Stainless Steel Bars and Shapes.

E. ASTM A 313 - Standard Specification for Stainless Steel Spring Wire.

F. ASTM B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit manufacturer's product data for proposed valves for approval.

1.05 QUALITY CONTROL

A. Provide manufacturer's affidavit that air release and vacuum relief valves purchased for Work, were manufactured and tested in United States, and conform to requirements of this Section.

PART 2 P R O D U C T S

2.01 DESCRIPTION

A. Provide combination air valves designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief.

B. Provide inlet and outlet connections, and orifice as shown on Drawings.

C. Valve exterior: Painted with shop-applied primer colored Pantone Purple 522 C.

2.02 MATERIALS

A. For approved manufacturers see Appendix for City of Seabrook Approved Products List.

B. Air Release Valves: Provide approved air release valves ASTM A 48, Class 30, cast iron; float and leverage mechanism with body and cover, ASTM A 240 or ASTM A 276 stainless steel; orifice and seat, stainless steel against Buna-N or Viton mechanically retained with hex head nut and bolt. Other valve internals shall be stainless steel or bronze.

C. Air Release and Vacuum Relief Valves (Combination Air Valves): Provide single-body, standard combination valves or duplex-body custom combination valves as indicated on Drawings.

1. For 2 inch and 3 inch, single-body valves, provide inlet and outlet size as shown on Drawings and orifice sized for 100 psi working pressure.

a. Valve materials: body, cover, and baffle, ASTM A 48, Class 35, or ASTM A 126, Grade B cast iron; plug or poppet, ASTM A 276 stainless steel; float, ASTM A 240 stainless steel; seat, Buna-N; other valve internals, stainless steel.

2. For 3 inch and larger duplex body valves as shown on Drawings, provide approved air release valve.

a. Air and vacuum valve (Combination Air Valves) materials: body and cover, ASTM A 48, Class 35, cast iron; float, ASTM A 240 stainless steel; seat, Type 304, stainless steel and Buna-N; other valve internals,

stainless steel or bronze.

b. Air release valve: Constructed as specified in paragraph above on Air Release Valves.

D. Vacuum Relief Valves: Provide approved air inlet vacuum relief valves with flanged inlet and outlet connections as shown on Drawings. Provide air release valves in combination with inlet and outlet, and orifice as shown on Drawings. Valve shall open under pressure differential not to exceed 0.25 psi.

1. Materials for vacuum relief valves: valve body, ASTM A 48, Class 35, cast iron; seat and plug, ASTM B 584 bronze, copper alloy 836; spring, ASTM A 313, Type 304, stainless steel; bushing, ASTM B 584 bronze, copper alloy 932; retaining screws, ASTM A 276, Type 304, stainless steel.

E. Additional Requirements for Wastewater Applications:

1. Air Release/Vacuum Relief Valves shall have a minimum seating pressure of 0 psi through a maximum operating pressure of 250psi

2. Valve bodies shall be constructed of 316Ti stainless steel.

3. The valves shall have an internal debris shield and debris screen or an alternative mechanism to prevent clogging of the orifice.

4. Rubber components used shall be suitable for wastewater application

F. Manholes: As shown on Drawings conforming to requirements of Section 02082 - Precast Concrete Manholes.

PART 3 EXECUTION

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02317 - Excavation and Backfill for Utilities.

3.02 SETTING VALVES IN MANHOLES AND VAULTS

A. If required by Project Manager, provide services of technical representative of valve manufacturer available on site during installation of valves.

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that parts are in satisfactory working condition.

C. Install valves and valve manholes and vaults where indicated on Drawings or as located by Project Manager. Set manholes and vaults plumb and as detailed. Center manholes on valves. Compact cement-stabilized sand around each manhole in accordance with Section 02317- Excavation and Backfill for Utilities. Compact cement-stabilized sand around each vault for minimum radius of 4 feet, or to

undisturbed trench face when less than 4 feet. Provide aboveground vents for manholes and vaults as indicated on Drawings.

3.03 DISINFECTION AND TESTING

A. Assist District with disinfection of valves and appurtenances as required by Section 02514 - Disinfection of Waterlines and test as required by Section 02515 - Hydrostatic Testing of Pipelines.

3.04 PAINTING OF PIPING AND VALVES

A. Paint piping and valves located in manholes, stations, and above ground using approved paint colored Pantone Purple 522 C.

END OF SECTION

Section 02527

POLYURETHANE COATINGS ON STEEL OR DUCTILE IRON PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyurethane coating system for use as steel pipe internal lining and external coatings, and external coating for ductile iron pipe.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. No separate payment will be made for work performed under this Section. Include cost of polyurethane coatings in contract unit prices for steel pipe or ductile iron pipe.

2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum): If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AWWA C 222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.

B. ASTM D 16 – Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.

C. ASTM D 522 - Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.

D. ASTM D 570 – Standard Test Method for Water Absorption of Plastics

E. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

F. ASTM D 4541 – Standard Test Method for Pull Off Strength of Coatings Using Portable Adhesion Testers

G. ASTM E 96 – Standard Test Method for Water Vapor Transmission of Materials

H. ASTM G 14 – Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)

I. ASTM G 95 – Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method)

J. NACE SP-0188 – Discontinuity (Holiday) Testing of Protective Coatings

K. NAPF 500-03 – Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings

L. SSPC-PA 2 - Measurement of Dry Paint Thickness with Magnetic Gauges.

M. SSPC-PA Guide 10 - A Guide to Safety and Health Requirements.

N. SSPC-SP 1 – Solvent Cleaning Surface Preparation

O. SSPC-SP10 - Near-White Metal Abrasive Blast Surface Preparation

P. SSPC-SP11 – Power Tool Clean to Bare Metal

1.4 SAFETY

A. Secure, from manufacturer, Material Safety Data Sheet (MSDS) for polyurethane coatings and repair materials listed in this Section.

B. Safety requirements stated in this specification and in related sections apply in addition to applicable federal, state and local rules and regulations. Comply with instructions of coating manufacturer and requirements of insurance underwriters.

C. Follow handling and application practices of SSPC-PA Guide 10, and Coating Manufacturer's Material Safety Data Sheet.

1.5 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit coating manufacturer's catalog sheets, product data sheets, material data sheets and other manufacturer's information for all material provided. Include manufacturer's recommendation and instructions for surface preparation, application and curing.

C. Quality Control Submittals. Furnish the following:

1. Shop and field applicator's experience with list of references substantiating compliance. Submit references of 5 successful projects completed within the last 3 years for each applicator. Each project listed should be at least 500 linear feet in length, unless otherwise approved by Project Manager.

2. Monitoring records for shop coated pipe, including coating "affidavit of compliance" to requirements of this Section stating that coatings were applied in factory, in accordance with manufacturer's requirements, and AWWA C222.

3. Factory applied coatings: Coating manufacturer's certification stating that the individual coating applicators have met the qualification certification requirements as specified in this Section.

4. Upon request by Project Manager, provide:

   a. Manufacturer's coating application Quality Control Manual

   b. Coating Performance Test report with statement that no reformulations have been made subsequent to the coating tests performed for the report.

   c. Current test equipment calibration certificates

5. Provide administrative documents showing that QA/QC personnel in both shop and field are certified as NACE International Coating Inspector (Level III).

6. Field applied coatings: Environmental monitoring records.

1.6 QUALITY ASSURANCE

A. Shop and Field Coating Applicator's Experience and Certification:

1. Minimum 5 years' practical experience in application of the specified products required for Coating Applicator and the coating application supervisor (Certified Applicator).

2. Minimum 2 years' practical experience in application of the specified coating system required for Coating application personnel whom have direct coating application responsibility.

3. Certification by coating manufacturer as an approved coating applicator required for Coating Applicator.

B. Shop: Unless otherwise approved by Project Manager, coating manufacturer's technical representative to be present for a minimum of three calendar days for

technical assistance and instruction at the start of coating operations within the shop. During this visit, technical representative to observe surface preparation and coating application, and conduct or observe tests of coating to ensure conformance with application instructions, recommended methods, and conditions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Use standard closed containers to prevent gelling, thickening deleteriously or forming of gas within period of one year from date of manufacture.

B. Label each container of separately packaged component clearly and durably to indicate date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name or formula specification, number of coatings together with special instructions. Do not use coating components older than one year.

C. Deliver coating materials to pipe manufacturer in sealed containers showing designated name, batch number, color, date of manufacture and name of coating manufacturer.

D. Store material onsite in enclosures, out of direct sunlight in warm, ventilated and dry area. Protect from freezing.

E. Prevent puncture, inappropriate opening or other action which may lead to product contamination.

1.8 OBSERVATION OF WORK

A. Provide minimum 14 days advance notice to Project Manager before start of coating or lining work to allow for scheduling of shop or field observation.

B. Provide full access to Project Manager for all facilities and documentation regarding surface preparation, environmental conditions and coating applications.

C. Observation by Project Manager or waiver of observation does not relieve Contractor of his responsibility to perform work in accordance with Specifications.

D. Materials are subject to testing for conformance with this specification.

E. Project Manager may retain services of independent, third-party NACE CIP Level III-Certified Inspector for partial or full-time inspection of the work.

PART 2 PRODUCTS

2.1 GENERAL

A. For approved manufacturers see Appendix for City of Seabrook Approved Products List.

B. Supply coating material in new, undamaged, labeled, unopened containers clearly and durably displaying date of manufacture, manufacturer's batch number, component identification, component color, manufacturer's name and product name. Store and handle in accordance with manufacturer's written instructions. Discard coating material that exceeds manufacturer's recommended shelf life, or is stored improperly, prior to usage, and replace with new material.

C. Clean, prime, and coat surfaces of pipe and fittings in accordance with referenced standards, written instructions by coating manufacturer, and these specifications.

D. Provide coating materials from single manufacturer. Product substitutions during project are not permitted without approval from Project Manager.

2.2 COATING MATERIAL

A. Coating System: ASTM D16 Type V thermoset, aromatic polyurethane plastic polymer in accordance with AWWA C222 (referred to as a polyurethane system).

B. Acceptable Materials:

1. DuraShield 210, 310 (External), DuraShield 210-61 NSF, 310-61 NSF (Internal), by LifeLast Inc., Pflugerville, TX,

2. Protec II (External), Protec II PW (Internal) by ITW PolySpec/Futura Coatings, Houston, TX,

3. Polyclad 777PL (External), Polyclad 767 (Internal) by Carboline, St. Louis, MO,

4. or approved equal.

C. Cured Coating Properties. In accordance with AWWA C222 except as follows:

1. ASTM E 96 Permeance using Water Procedure BW (App. X1): no more than 0.16 inch-lb.

2.3 SURFACE PREPARATION

A. The requirements listed below are for surface preparation procedures in the factory. For surface preparation in the field, refer to Part 3 – Execution.

B. Steel Pipe. In accordance with coating manufacturer's requirements.

C. Ductile Iron Pipe. Prepare surface in accordance with manufacturer's recommendations and NAPF 500-03.

1. Provide uncoated ductile iron pipe when polyurethane coatings are used. Do not apply asphaltic coating to ductile iron pipe and then attempt to remove prior to polyurethane coating application.

2. Do not apply surface preparation that is designed for steel pipe to ductile iron pipe. Unlike steel surfaces, it is possible to over blast the external surface of ductile iron pipe. Consult ductile iron pipe and polyurethane coating manufacturer regarding method of application and surface preparation to be used.

2.4 FACTORY APPLICATION OF POLYURETHANE

A. Equipment: As required by manufacturer.

B. Temperature: Minimum 5 degrees F above dew point temperature. Temperature of surface shall not be less than 50 degrees F during application or as per manufacturers recommendation.

C. Humidity: Heating of pipe surfaces may be required when relative humidity exceeds 80 percent.

D. Do not thin or mix resins; use as received. Store resins at temperature above 55 degrees F at all times or as manufacturers recommendation.

E. Application: Conform to coating manufacturer's recommendations. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

F. Recoat only when coating has cured less than maximum time specified by coating manufacturer. When coating has cured for more than recoat time, follow coating manufacturers recommendations for recoating.

G. Cure and perform cure test in accordance with manufacturer's recommendations prior to handling, inspection, testing, and placement in service.

2.5 FACTORY INSPECTION

A. Project Manager may inspect coatings at coating applicator's facilities.

B. Inspection procedures to be in accordance with AWWA C222. Conduct inspection any time after coating has reached initial cure. Repair in accordance with manufacturer's requirements and these specifications.

C. Remove rejected coating from the full length of pipe to bare metal and reapply using proper application methods.

2.6 HOLDBACK COATING SYSTEM

A. Provide holding primer for corrosion protection of cutbacks or holdbacks compatible with specified joint coating system and weld after backfill requirements, where applicable.

B. Holdback coating to prevent corrosion of prepared pipe ends for duration of storage and construction, and recommended for buried exposures.

C. Primer should not result in running or melting of coating and causing toxic fumes when heated during welding on weld after backfill joints.

D. Apply holding primer in accordance with primer manufacturer's recommendations, but maintain clearances required for proper joint installation as recommended by pipe manufacturer.

E. Ductile Iron Joints: Apply coating to unlined pipe surfaces including inside of bell socket and outside of spigot. Coating thickness on sealing areas of spigot end of pipe exterior: minimum 8 mils (0.008 inch), maximum of 10 mils (0.010 inch). Maximum 10 mils may be exceeded in spigot end provided maximum spigot diameter as specified by pipe manufacturer is not exceeded and approved by pipe manufacturer.

F. Welded joints:

1. Field welded on the inside: Provide four-inch coating holdback on spigot end and six-inch coating holdback on bell end.

2. Field welded on the outside: Provide six-inch coating holdback on the spigot end, and four-inch coating holdback on the bell end.

2.7 THICKNESS

A. External Coatings: Minimum DFT of 25 mils (0.025 inch).

B. Internal Coatings (Linings): Minimum DFT of 25 mils.

C. Thickness Determinations: Use Type 1 magnetic thickness gauge as described in SSPC-PA2 specification. No single gauge reading may be less than specified thickness.

D. Do not accept pipe with deficient coating thickness. If pipe in field is found to have a coating thickness as measured by SSPC PA-2 that is less than the specified thickness, the pipe segment shall be rejected.

2.8 FACTORY REPAIR OF INTERNAL AND EXTERNAL COATINGS

A. The procedures listed below are for repairs made to internal and external coatings in the factory. For field repairs, see Part 3 – Execution.

B. Defect size is defined as follows: Minor – less than 6 inches by greatest dimension. Major – exceeds 6 inches by greatest dimension.

C. General

1. Repair areas where holidays are detected or coating is visually damaged, such as blisters, bubbles, cuts, or other defects.

2. Provide coating repair materials that are compatible with the shop-applied coating system and approved by coating manufacturer.

3. Provide repair materials as required for the coating system and repair classification.

D. Repair Materials:

1. Provide polyurethane, single use kits that are supplied by parent coating manufacturer.

2. For major repairs in the shop, reapply using plural component spray equipment by a manufacturer certified coating applicator.

E. For internal coatings, five repairs maximum allowed per 100 square feet of pipe for internal linings. If this number is exceeded, pipe must be stripped of lining, re-blasted, and recoated in factory.

PART 3 EXECUTION

3.1 FIELD ENVIRONMENTAL CONTROLS

A. General

1. Do not apply coatings when:

a. Surface or ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer.

b. In dust or smoke-laden atmosphere, blowing dust or debris, or under conditions that can cause icing on metal surface.

c. When it is expected surface temperatures may drop below 5 degrees above dew point within 4 hours after application of coating.

d. Whenever relative humidity exceeds 85 percent or the maximum recommended by the coating manufacturer.

2. When weather conditions dictate, provide and operate heaters and dehumidification equipment to allow pipe surfaces to be prepared and coated as specified and in accordance with the manufacturers coating application recommendations.

3. Do not proceed with surface preparation and coating application activities until adequate temperature and humidity controls are in place and functioning within environmental limits specified.

4. Monitor ambient temperature, relative humidity, dew point, temperature, and pipe surface temperature (work area only) in strict conformance with manufacturer's requirements, but not greater than 5 hours between measurements. Document and submit environmental monitoring records to Project Manager upon completion, if requested.

3.2 PIPE INSTALLATION

A. When required by Project Manager, provide services of pipe manufacturer's representative for period of not less than 2 weeks at beginning of actual pipe laying operations to advise Contractor regarding installation including but not limited to handling and storing, cleaning and inspecting, coatings repairs, and general construction methods as to how they may affect pipe coatings.

B. When required by Project Manager, coating manufacturer's technical representative to provide a written report to the Project Manager for each visit. Include copies of test data collected, description of observations, and all recommended corrective actions. Submit within five working calendar days after the visit. After corrective actions are complete, representative to certify application complies with manufacturer's coating application recommendations.

C. Use nylon straps, padded lifts and padded storage skids. Field cuts should be kept to minimum. Repair damage to coating due to handling or construction practices.

D. Just before each section of pipe is to be placed into trench, conduct visual and holiday inspection in accordance with AWWA C222. Repair defects in coating system before pipe is installed.

E. For field-welded joints, drape minimum 18-inch wide strip of heat-resistant material over top half of pipe on each side of the coating holdback to protect from weld spatter.

F. Provide transition from cement mortar lining to polyurethane lining in accordance with coating manufacturer's recommendations and as approved by Project Manager.

3.3 FIELD REPAIR AND TOUCHUP

A. Apply repair and touchup materials in conformance with manufacturer's recommendations.

B. Repair Procedure – Joints:

1. External Joints. Provide heat shrink sleeve in accordance with Section 02518 – Steel Pipe for Large Diameter Water Lines. Metal surface must be free of all dirt, dust, and surface corrosion prior to sleeve application. Where corrosion in the holdback area is visible, prepare surface in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal for steel pipe, or NAPF 500-03-03 Power Tool Cleaning for ductile iron pipe

2. Internal Joints. Prepare surface and provide environmental controls in accordance with manufacturer's recommendations.

a. Remove oil or grease by solvent wiping pipe and adjacent coating in accordance with SSPC-SP1, Solvent Cleaning.

b. Clean pipe surface in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasively blast in the field in accordance with SSPC-SP10, Near-White Metal Blast Cleaning. Clean the full circumference of the pipe and feather the edges of the existing polyurethane coating a minimum of two inches.

c. Remove loose or damaged pipe lining at joint and repair as specified herein, or extend joint lining.

d. Apply lining material by hand or spray equipment. Provide material that is compatible with shop lining and approved by manufacturer.

e. Provide a NACE Level II or III inspector experienced with the applied coating system to inspect surface preparation of the joint lining and document application conditions. Submit documentation to Project Manager.

C. Repair Procedure – Field Defects:

1. Repair Materials (subject to Project Manager's approval):

a. Heat-applied repair patches

b. Single use polyurethane coating kits that control mix ratios

c. Coating manufacturer's polyurethane coating repair products

2. Repair Procedures:

a. Solvent clean in accordance with SSPC-SP1 for steel pipe or NAPF 500-03-01 for ductile iron pipe.

b. Power tool clean in accordance with SSPC-SP11 for steel pipe and NAPF 500-03-03 for ductile iron pipe. Feather the coating and provide overlap in accordance with a manufacturer's recommendations.

c. Apply repair material as described above in accordance with manufacturer's recommendations.

d. If a heat-applied repair patch is used, do not overlap patches or use more than one patch for a single repair. If repair area exceeds the size of a single patch, use alternate repair method as listed above.

D. Repair Procedure - Thermite Brazed Connection Bonds:

1. Remove polyurethane coating with power wire brush from area on metal surface which is to receive thermite brazed connection.

2. Grind metal surface to shiny metal with power grinder and coarse grit grinding wheel.

3. Apply thermite-brazed connection using equipment, charge and procedure recommended by manufacturer of thermite equipment.

4. Drape minimum 18-inch wide strip of heat-resistant material over top half of pipe on all sides during welding to protect from weld spatter.

5. After welded surface has cooled to temperature below 130 degrees F, apply protective coating repair material to weld, exposed pipe surface and damaged areas of polyurethane coating. A heat-applied repair patch may be used as approved by Project Manager.

6. Do not cover or backfill freshly repaired areas of coating at thermite-brazed connection until repair material has completely cured. Allow material to cure in conformance with manufacturer's recommendations.

END OF SECTION

Section 02531

GRAVITY SANITARY SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gravity sanitary sewers and appurtenances, including stacks and service connections.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for Gravity Sanitary Sewers, include the price in the lump sum bid price and the Schedule of Values.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittal Procedures.

B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. Qualifications. Install a sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 02533 - Acceptance Testing for Sanitary Sewers.

B. Regulatory Requirements.

1. Install sewer lines to meet the minimum separation distance from any potable water line, as scheduled below. The separation distance is defined as the distance between the outside of the water pipe and the outside of the sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.

2. Make notification to the City Engineer if water lines are uncovered during sanitary sewer installation where the minimum separation distance cannot be maintained.

3. Lay gravity sewer lines in straight alignment and grade.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at the job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along the ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around the outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with the interior surface of the pipe to lift or move lined pipe.

PART 2 P R O D U C T S

For approved manufacturers see Appendix for City of Seabrook Approved Products List.

2.01 PIPE

A. Provide piping materials for gravity sanitary sewers of the sizes and types indicated on the Drawings or as specified.

B. Unlined reinforced concrete pipe is not acceptable.

2.02 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02501 – Ductile Iron Pipe and Fittings.

2. Section 02506 - PVC Pipe.

B. Where shown on the Drawings, provide pipe meeting the minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.03 APPURTENANCES

A. Stacks. Conform to the requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections.

B. Service Connections. Conform to requirements of Section 02534 - Sanitary Sewer Service Stubs or Reconnections.

C. Roof, street or other type of surface water drains shall not be connected or reconnected into the sanitary sewer lines.

2.04 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Section 02317 - Excavation and Backfill for Utilities, Section 02320 - Utility Backfill Material, and Section 02321 - Cement Stabilized Sand.

B. Topsoil: Conform to requirements of Section 02911 - Topsoil.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01555 - Traffic Control and Regulation.

B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning lights where work is in progress or where traffic is affected by the work.

C. Perform work in accordance with OSHA standards. Employ a trench safety system as specified in Section 02260 - Trench Safety System for excavations over 5 feet deep.

D. Immediately notify the agency or company owning any utility line which is damaged, broken or disturbed. Obtain approval from City Engineer and agency or utility company for any repairs or relocations, either temporary or permanent.

E. Install and operate dewatering and surface water control measures in accordance with Section 01578 - Control of Ground Water and Surface Water.

F. Do not allow sand, debris or runoff to enter sewer system.

3.02 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from City Engineer.

B. Design piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into any area outside of the sanitary sewer.

D. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify District Manager so that required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency by the District Manager.

3.03 EXCAVATION

A. Earthwork. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish the required uniform line and grade in the trench from benchmarks identified by the Engineer. Maintain this control for a minimum of 100 feet behind and ahead of the pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of the work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect the boards and location stakes from damage or dislocation

C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 02317 - Excavation and Backfill for Utilities.

3.04 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with the pipe manufacturer's recommendations and as specified in the following paragraphs.

B. Install pipe only after excavation is completed, the bottom of the trench fine graded, bedding material is installed, and the trench has been approved by the Engineer.

C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

D. Install pipe with the spigot ends toward the direction of flow.

E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by City Engineer.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

J. Where a gravity sanitary sewer is to be installed under an existing water line with a separation distance of at least 2 feet and less than 9 feet, install the new sewer pipe so that one full joint length of pipe is centered on the water line crossing. Embed the sewer pipe in cement stabilized sand for a minimum distance of 9 feet on each side of the crossing.

K. Where a gravity sanitary sewer is to be installed under an existing water line with a separation distance of less than 2 feet, install the new sewer using pressure-rated pipe as shown on the Drawings. Maintain a minimum 6-inch separation distance.

L. Where the length of stubs is not indicated, install a 4-foot length and seal the free end with an approved plug.

3.05 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

3.06 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Section 02317 - Excavation and Backfill for Utilities.

END OF SECTION

Section 02532

SANITARY SEWER FORCE MAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewer force mains.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment for installation of force main pipe by open-cut, augered with or without casing. Include cost in lump sum bid price and Schedule of Values.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCE STANDARDS

A. ACI 318 - ACI Building Code and Commentary.

B. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 C and 30 C with a Vitreous Silica Dilatometer.

C. ASTM D 2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber Reinforced- Thermosetting-Resin) Pipe.

D. ASTM D 2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.

E. ASTM D 2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe.

F. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Force mains 24 inches in diameter and larger: Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

D. Submit qualifications, proposed methods, equipment, materials, and sequence for acceptance testing of pipeline. Submit evidence of experience with pipeline proving by pigging for at least three projects of equal or greater scope; project list shall include dates, size and length of pipe, location, owner name, contact person, and telephone number. Provide certificate of training by manufacturer of pigging equipment being used.

E. Submit test reports as specified in Part 3 of this Section.

PART 2 PRODUCTS

For approved manufacturers see Appendix for City of Seabrook Approved Products List.

2.01 PIPE FITTING MATERIAL SCHEDULE

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02501 - Ductile-Iron Pipe and Fittings.

2. Section 02504 - Fiberglass Reinforced Pipe.

3. Section 02505 - High Density Polyethylene Solid and Profile Wall Pipe (HDPE).

4. Section 02506 - Polyvinyl Chloride Pipe. Provide Lined Ductile-Iron Fittings in Accordance with Section 02501 - Ductile-Iron Pipe and Fittings.

5. Section 02509 – Fiberglass Reinforced Pipe for Pressure Mains

B. Pipe shall be color coded green.

2.02 THRUST RESTRAINT

A. Unless otherwise shown on Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete, as specified in Section 03315 - Concrete for Utility Construction. Place concrete in accordance with details on Drawings. Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below pipe or fitting to 12 inches above.

B. For force mains larger than 12 inches in diameter, and where indicated on Drawings,

provide restrained joints conforming to requirements of force main pipe material specifications. Install restrained joints for length of pipe on both sides of each bend or fitting for full length shown on Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends between 10 degrees and 90 degrees deflection angle shall have thrust restraint as shown on Drawings.

E. Provide thrust restraint at tees, plugs, blowoff drains, valves, and caps, as indicated.

F. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to following design requirements.

1. Design calculations shall be performed and sealed by Professional Engineer licensed in State of Texas.

2. Base design calculations upon soil parameters quantified in geotechnical report for site where alternative thrust restraint system is to be installed. When data is not available for site, use parameters recommended by geotechnical engineer.

3. The design system pressure shall be specified test pressure.

4. The following safety factors shall be used in sizing restraint system:

   a. Apply factor of safety equal to 1.5 for passive soil resistance.

   b. Apply factor of safety equal to 2.0 for soil friction.

5. Contain encasement entirely within standard trench width and terminate on both ends at pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads, including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 EXECUTION

3.01 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.

B. Wrap ductile-iron pipe and fittings with polyethylene wrap in accordance with requirements of Section 02528 - Polyethylene Wrap. Do not install polyethylene wrap

on ductile iron pipe protected by cathodic protection system or fusion bonded or polyurethane coated fittings.

C. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.

D. Install pipe only after excavation is completed, bottom of trench is fine graded, bedding material is installed, and trench has been approved by Project Manager.

E. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

F. Install pipe with spigot ends toward direction of flow. Form concentric joint with each section of adjoining pipe so as to prevent offsets.

G. Keep interior of pipe clean as installation progresses. Where cleaning after laying pipe is difficult because of small pipe size, use suitable swab or drag in pipe and pull it forward past each joint immediately after joint has been completed. Remove foreign material and debris from pipe.

H. Provide lubricant, place and drive home newly-laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Project Manager.

I. Keep excavations free of water during construction and until final inspection.

J. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

K. Where sanitary sewer force main is to be installed under existing water line with separation distance of less than 2 feet, install one full joint length of pipe, minimum 18 foot length, centered on water line and maintain minimum 6-inch separation distance.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification section of augering or tunneling work.

3.03 HYDROSTATIC TESTING

A. After pipe and appurtenance have been installed, test line and drain. Prevent damage to Work or adjacent areas. Use clean water to perform tests.

B. Project Manager may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in presence of Project Manager.

D. Test pipe at 150 psig or 1.5 times design pressure of pipe, whichever is greater. Design pressure of force main shall be rated total dynamic head of lift station pump.

E. Test pipe at required pressure for minimum of 2 hours according to requirements of UNI-B-3.

F. Maximum allowable leakage shall be as calculated by following formula:

$$L = (S)\,(D)\,(P^{0.5}) / 155{,}400$$

Where:	L	=	Leakage in gallons per hour per 1,000 feet of pipe
	S	=	Length of pipe in feet.
	D	=	Inside diameter of pipe in inches.
	P	=	Pressure in pounds per square inch.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by Project Manager.

H. Plug openings in force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering tested pipeline.

3.04 PIGGING TEST

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of open-cell polyurethane foam body, without coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of nominal cross-sectional area of pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to force main being tested.

C. Test Execution: Conduct pigging test in presence of Project Manager. Provide at least 48- hours notice of scheduled pigging of force main prior to commencing test.

END OF SECTION

Section 03211

REINFORCING STEEL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

1.02 UNIT PRICES

A. No separate payment will be made for reinforcing steel or grouting that is part of the Work as bid.

B. Measurement for reinforcing steel installed as extra work is on a per-pound basis.

C. Include price of reinforcing steel in lump sum bid of project.

1.03 REFERENCES

A. ACI 315 - Details and Detailing of Concrete Reinforcement.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ASTM A 36 - Standard Specification for Structural Steel.

D. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

E. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

F. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

G. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

H. ASTM A 675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

I. ASTM A 775/A 775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

J. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

K. AWS D 1.4 - Structural Welding Code - Reinforcing Steel.

L. WRI - Manual of Standard Practice for Welded Wire Fabric.

M. CRSI MSP-1 - Manual of Standard Practice.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Shop Drawings:

1. Submit shop drawings detailing reinforcement fabrication, bar placement location, splices, spacing, bar designation, bar type, length, size, bending, number of bars, bar support type and other pertinent information, including dimensions. Provide sufficient detail for placement of reinforcement without use of Contract Drawings. Information shall correspond directly to data listed on bill of materials.

2. Use of reproductions of Contract Drawings by Contractor, Subcontractor, erector, fabricator or material supplier in preparation of shop drawings (or in lieu of preparation of shop drawings) signifies acceptance by that party of information shown thereon as correct, and acceptance of obligation to pay for any job expense, real or implied, arising due to errors that may occur thereon. Remove references to Design Engineer, including seals, when reproductions of Contract Drawings are used as shop drawings.

3. Detail shop drawings in accordance with ACI 315, Figure 6.

4. Submit shop drawings showing location of proposed additional construction joints.

C. Bill of Materials: Submit with shop drawings.

D. Product Data:

1. Mechanical Bar Splices: Submit manufacturer's technical literature, including specifications and installation instructions.

2. Epoxy grout proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures.

E. Certificates:

1. Submit steel manufacturer's certificates of mill tests giving properties of steel proposed for use. List manufacturer's test number, heat number, chemical analysis, yield point, tensile strength and percentage of elongation. Identify proposed location of steel in work.

2. Foreign-manufactured reinforcing bars shall be tested for conformance to ASTM

requirements by a certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Submit test reports for review. Do not begin fabrication of reinforcement until material has been approved.

1.05 HANDLING AND STORAGE

A. Store steel reinforcement above ground on platforms, skids or other supports. Protect reinforcing from mechanical injury, surface deterioration and formation of excessive, loose or flaky rust caused by exposure to weather. Protect epoxy-coated reinforcing from formation of any amount of rust.

1.06 QUALITY ASSURANCE

A. Notify Engineer at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

PART 2 PRODUCTS

2.01 MATERIAL

A. Reinforcing Bars: Deformed bars conforming to ASTM A 615, grade as indicated on Drawings, except column spirals and those shown on Drawings to be smooth bars. Where grade is not shown on Drawings, use Grade 60.

B. Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A 36; ASTM A 615, Grade 60; or ASTM A 675, Grade 70.

C. Column Spirals: Bars conforming to ASTM A 615, Grade 60, or wire conforming to ASTM A 82.

D. Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars: Conform to ASTM A 775/A 775M.

E. Welded Wire Fabric:

1. Welded Smooth Wire Fabric: Conform to ASTM A 185.

2. Welded Deformed Wire Fabric: Conform to ASTM A 497.

3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire fabric.

4. Furnish welded wire fabric in flat sheets only.

F. Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.

G. Bar Supports: Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use bar supports and accessories of sizes required to provide required concrete cover. Where concrete surfaces are exposed to weather, water or wastewater, provide plastic accessories only; do not use galvanized or plastic-tipped metal in such locations. Provide metal bar supports and accessories rated Class 1 or 2 conforming to CRSI MSP-1 Manual of Standard Practice. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.

H. Slabs on Grade: Provide chairs with sheet metal bases or provide precast concrete bar supports 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side.

I. Mechanical Bar Splices:

1. Conform to ACI 318; use where indicated on Drawings.

   a. Compression splices shall develop ultimate stress of reinforcing bar.

   b. Tension splices shall develop 125 percent of minimum yield point stress of reinforcing bar.

2. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.

J. Welded Splices:

1. Provide welded splices where shown and where approved by the Engineer. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.
2. Provide materials for welded splices conforming to AWS D1.4.

K. Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C 881, Type IV, manufactured for purpose of anchoring dowels into hardened concrete and the moisture condition, application temperature and orientation of the hole to be filled. Unless otherwise shown, depth of embedment shall be as required to develop the full tensile strength (125 percent of yield strength) of dowel, but not less than 12 diameters.

2.01.1 FABRICATION

A. Bending: Fabricate bars to shapes indicated on Drawings by cold bending. Bends shall conform to minimum bend diameters specified in ACI 318. Do not straighten or rebend bars. Fabricate epoxy-coated reinforcing steel to required shapes in a manner that will not damage epoxy coating. Repair any damaged epoxy coating with patching material conforming to Item 4.4 of ASTM A 775/A 775M.

B. Splices:

1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of Engineer. Use minimum number of splices located at points

of minimum stress. Stagger splices in adjacent bars.

2. Length of lap splices: As shown on Drawings.

3. Prepare ends of bars at mechanical splices in accordance with splice manufacturer's requirements.

C. Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.

D. Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 4 and 5.

E. Standard Hooks: Conform to the requirements of ACI 318.

F. Marking: Clearly mark bars with waterproof tags showing number of bars, size, mark, length and yield strength. Mark steel with same designation as member in which it occurs.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

3.02 INSTALLATION

A. Placement Tolerances: Place reinforcement within tolerances of Table 03211A at the end of this Section. Bend tie wire away from forms to maintain the specified concrete coverage.

B. Interferences: Maintain 2-inch clearance from embedded items. Where reinforcing interferes with location of other reinforcing steel, conduit or embedded items, bars may be moved within specified tolerances or one bar diameter, whichever is greater. Where greater movement of bars is required to avoid interference, notify Engineer. Do not cut reinforcement to install inserts, conduit, mechanical openings or other items without approval of Engineer.

C. Concrete Cover: Provide clear cover measured from reinforcement to face of concrete as listed in Table 03211B at the end of this Section, unless otherwise indicated on Drawings.

D. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to assemble, space and support reinforcing properly. Provide accessories of sufficient number, size and strength to 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.

E. Placement for Concrete on Ground: Support bar and wire reinforcement on chairs with sheet metal bases or precast concrete blocks spaced at approximately 3 feet on centers each way. Use minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires.

F. Vertical Reinforcement in Columns: Offset vertical bars by at least one bar diameter at splices. Provide accurate templates for column dowels to ensure proper placement.

G. Splices:

1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of Engineer.

2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to ACI 318-89, Section 12.15.1. Tie securely with wire prior to concrete placement, to prevent displacement of splices during concrete placement.

3. Mechanical Bar Splices: Use only where indicated on Drawings or approved by the Engineer. Install in accordance with manufacturer's instructions.

a. Couplers located at a joint face shall be of a type which can be set either flush or recessed from the face as shown. Seal couplers prior to concrete placement to completely eliminate concrete or cement paste from entering.

b. Couplers intended for future connections: Recess 1/2 inch minimum from concrete surface. After concrete is placed, plug coupler and fill recess with sealant to prevent contact with water or other corrosive materials.

c. Unless noted otherwise, match mechanical coupler spacing and capacity to that shown for the adjacent reinforcing.

H. Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.

I. Welded Wire Fabric: Install wire fabric in as long lengths as practicable. Unless otherwise indicated on Drawings, lap adjoining pieces at least 6 inches or one full mesh plus 2 inches, whichever is larger. Lace splices with wire. 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. Conform to WRI - Manual of Standard Practice for Welded Wire Fabric.

J. Field Bending: Shape reinforcing bent during construction operations to conform to

Drawings. Bars shall be cold-bent; do not heat bars. Closely inspect reinforcing for breaks. When reinforcing is damaged, replace, Cadweld, or otherwise repair, as directed by Engineer. Do not bend reinforcement after it is embedded in concrete.

K. Epoxy-coated Reinforcing Steel: Install in accordance with Paragraph 3.02J, Field Bending, and in a manner that will not damage epoxy coating. Repair damaged epoxy coating with patching material as specified in Paragraph 2.02A, Bending.

L. Field Cutting: Cut reinforcing bars by shearing or sawing. Do not cut bars with cutting torch.

M. Welding of reinforcing bars is prohibited, except where shown on Drawings.

3.03 GROUTING OF REINFORCING AND DOWEL BARS

A. Use epoxy grout for anchoring reinforcing and dowel steel to existing concrete in accordance with epoxy manufacturer's instructions. Drill hole not more than 1/4 inch larger than steel bar diameter (including height of deformations for deformed bars) in existing concrete. Just before installation of steel, blow hole clean of all debris using compressed air. Partially fill hole with epoxy, using enough epoxy so when steel bar is inserted, epoxy grout will completely fill hole around bar. Dip end of steel bar in epoxy and twist bar while inserting into partially-filled hole.

Table 03211A
REINFORCEMENT PLACEMENT TOLERANCES

PLACEMENT	TOLERANCE IN INCHES
Clear Distance -	
To formed soffit:	-1/4
To other formed surfaces:	±1/4
Minimum spacing between bars:	-1/4
Clear distance from unformed surface to top reinforcement -	
Members 8 inches deep or less:	±1/4
Members more than 8 inches deep but less than 24 inches deep:	-1/4, +1/2
Members 24 inches deep or greater:	-1/4, +1
Uniform spacing of bars (but the required number of bars shall not be reduced):	±2
Uniform spacing of stirrups and ties (but the required number of stirrups and ties shall not be reduced):	±1
Longitudinal locations of bends and ends of reinforcement -	
General:	±2
Discontinuous ends of members:	±1/2
Length of bar laps:	-1-1/2
Embedded length -	
For bar sizes No. 3 through 11:	-1
For bar sizes No. 14 and 18:	-2

Table 03211B
MINIMUM CONCRETE COVER FOR REINFORCEMENT

SURFACE	MINIMUM COVER IN INCHES
Slabs and Joists -	
Top and bottom bars for dry conditions -	
No. 14 and No. 18 bars:	1-1/2
No. 11 bars and smaller:	1
Formed concrete surfaces exposed to earth, water or weather; over, or in contact with, sewage; and for bottoms bearing on work mat, or slabs supporting earth cover -	
No. 5 bars and smaller:	1-1/2
No. 6 through No. 18 bars:	2
Beams and Columns -	
For dry conditions -	
Stirrups, spirals and ties:	1-1/2
Principal reinforcement:	2
Exposed to earth, water, sewage or weather -	
Stirrups and ties:	2
Principal reinforcement:	2-1/2
Walls -	
For dry conditions -	
No. 11 bars and smaller:	1
No. 14 and No. 18 bars:	1-1/2
Formed concrete surfaces exposed to earth, water, sewage or weather, or in contact with ground -	
Circular tanks with ring tension:	2
All others:	2
Footings and Base Slabs -	
At formed surfaces and bottoms bearing on concrete work mat:	2
At unformed surfaces and bottoms in contact with earth:	3
Over top of piles:	2
Top of footings -- same as slabs	

END OF SECTION

Section 03310

STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place normal-weight structural concrete and mass concrete.

1.02 UNIT PRICES

A. Measurement for structural concrete is on lump-sum basis for the project. The Contractor should estimate the amount of structural concrete required to complete the structures on the project, and incorporate into the lump sum bid and reflect in the Schedule of Values.

B. Measurement for extra structural concrete is on cubic-yard basis. Payment includes related work performed in accordance with related sections.

1.03 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 304.2R - Placing Concrete by Pumping Methods

C. ACI 305R - Hot Weather Concreting.

D. ACI 306.1 - Standard Specification for Cold Weather Concreting.

E. ACI 309R - Guide for Consolidation of Concrete.

F. ACI 318 - Building Code Requirements for Reinforced Concrete.

G. ACI 350R - Environmental Engineering Concrete Structures.

H. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

I. ASTM C 33 - Standard Specification for Concrete Aggregates.

J. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

K. ASTM C 42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

L. ASTM C 88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

M. ASTM C 94 - Standard Specifications for Ready-Mixed Concrete.

N. ASTM C 127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.

O. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

P. ASTM C 136 - Sieve Analyses of Fine and Coarse Aggregates.

Q. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

R. ASTM C 150 - Standard Specification for Portland Cement.

S. ASTM C 157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.

T. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

U. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

V. ASTM C 192 - Method of Making and Curing Concrete Test Specimens in the Laboratory.

W. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

X. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

Y. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

Z. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

AA. ASTM C 535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

AB. ASTM C 567 - Standard Test Method for Unit Weight of Structural Lightweight Concrete.

AC. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

AD. Concrete Plant Manufacturer's Bureau (CPMB), Plant Mixer Manufacturers Division: Concrete Plant Mixer Standards.

AE. National Ready-Mixed Concrete Association (NRMCA): Certification of Ready-Mixed Concrete Production Facilities (checklist with instructions).

AF. John Wiley and Sons, Interscience Publishers Division, "Encyclopedia of Industrial Chemical Analysis," Vol. 15, Page 230 (alkalinity test procedure).

1.04 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

B. Hot Weather: Any combination of high air temperature, low relative humidity and wind velocity tending to impair quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

C. Cold Weather: Period when, for more than 2 successive days, mean daily temperature is below 40 degrees F.

1.05 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Mill Certificates: Required for bulk cement.

C. Design Mixes:

1. Submit test data on proposed design mixes for each type of concrete in the Work, including each class, and variations in type, source or quantity of material. Include type, brand and amount of cementitious materials; type, brand and amount of each admixture; slump; air content; aggregate sources, gradations, specific gravity and absorption; total water (including moisture in aggregate); water/cement ratio; compressive strength test results for 7 and 28 days; and shrinkage tests for Class C and D concrete at 21 or 28 days of drying.

2. Submit abrasion loss and soundness test results for limestone aggregate.

3. Testing of aggregates, including sieve analysis, shall be performed by a certified independent testing laboratory. Tests shall have been performed no earlier than 3 months before Notice to Proceed.

4. Provide standard deviation data for plant producing concrete. Data shall include copies of laboratory test results and standard deviation calculated in accordance with ACI 318, Item 5.3.1. Laboratory tests shall have been performed within past 12 months. When standard deviation data is not available, comply with ACI 318, Table 5.3.2.2.

5. Review and acceptance of mix design does not relieve Contractor of responsibility to provide concrete of quality and strength required by these Specifications.

D. Admixtures: Submit manufacturer's technical information, including following:

1. Air-Entraining Admixture: Give requirements to control air content under all conditions, including temperature variations and presence of other admixtures.

2. Chemical Admixtures: Give requirements for quantities and types to be used under various temperatures and job conditions to produce uniform, workable concrete mix. Submit evidence of compatibility with other admixtures and cementitious materials proposed for use in design mix.

E. High-range Water Reducer (Superplasticizer): When proposed for use, submit manufacturer's technical information and instructions for use of superplasticizer. State whether superplasticizer will be added at ready-mix plant or job site. When superplasticizer will be added at job site, submit proposed plan for measuring and adding superplasticizer to concrete mix at job site, and establish dosing area on site with holding tanks and metering devices. When superplasticizer is to be added at ready-mix plant, submit contingency plans for adding additional superplasticizer at job site when required due to delay in placing concrete. Identify portions of Work on which superplasticizer is proposed for use.

F. Hot and Cold Weather Concreting: Submit, when applicable, proposed plans for hot and cold weather concreting. Review and acceptance of proposed procedure will not relieve Contractor of responsibility for quality of finished product.

G. Project Record Drawings: Accurately record actual locations of embedded utilities and components which are concealed from view.

1.06 QUALITY ASSURANCE

A. Provide necessary controls during evaluation of materials, mix designs, production and delivery of concrete, placement and compaction to assure that the Work will be accomplished in accordance with Contract Documents. Maintain records of concrete placement. Record dates, locations, quantities, air temperatures, and test samples taken.

B. Code Requirements: Concrete construction for buildings shall conform to ACI 318. Concrete construction for water and wastewater treatment and conveying structures shall conform to ACI 318 with modifications by ACI 350R, Item 2.6. Where this Specification conflicts with ACI 318 or ACI 350R, this Specification governs.

C. Testing and Other Quality Control Services:

1. Concrete testing required in this section, except concrete mix design, limestone aggregate test data, and testing of deficient concrete, will be performed by an

independent commercial testing laboratory employed and paid by the District in accordance with Section 01454 - Testing Laboratory Services.

2. Provide material for and cooperate fully with City's testing laboratory technician in obtaining samples for required tests.

3. Standard Services: The following testing and quality control services will be provided by District in accordance with Section 01454, Testing Laboratory Services:

   a. Verification that plant equipment and facilities conform to NRMCA "Certification of Ready-Mix Concrete Production Facilities".

   b. Testing of proposed materials for compliance with this Specification.

   c. Review of proposed mix design submitted by Contractor.

   d. Obtaining production samples of materials at plants or stockpiles during work progress and testing for compliance with this Specification.

   e. Strength testing of concrete according to following procedures:

      (1) Obtaining samples for field test cylinders from every 100 cubic yards and any portion less than 100 cubic yards for each mix design placed each day, according to ASTM C 172, with each sample obtained from a different batch of concrete on a representative, random basis. Selecting test batches by any means other than random numbers chosen before concrete placement begins is not allowed.

      (2) Molding four specimens from each sample according to ASTM C 31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C 31.

      (3) Testing two specimens at 7 days and two specimens at 28 days according to ASTM C 39, reporting test results averaging strengths of two specimens. However, when one specimen evidences improper sampling, molding or testing, it will be discarded and remaining cylinder considered test result. When high-early-strength concrete is used, specimens will be tested at 3 and 7 days.

   f. Air content: For each strength test, determination of air content of normal weight concrete according to ASTM C 231.

   g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C 143.

h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C 1064.

i. Lightweight concrete: For each strength test, or more frequently when requested by Project Manager, determination of air content by ASTM C 567 and unit weight by ASTM C 567.

j. Monitoring of current and forecasted climatic conditions to determine when rate of evaporation, as determined by Figure 2.1.5 of ACI 305R, will produce loss of 0.2 pounds of water, or more, per square foot per hour. Testing lab representative will advise Contractor to use hot weather precautions when such conditions will exist during concrete placement, and note on concrete test reports when Contractor has been advised that hot weather conditions will exist.

k. Class A and D Concrete Shrinkage Tests: Performance of drying shrinkage tests for trial batches as follows:

(1) Preparation and Testing of Specimens: Compression and drying shrinkage test specimens will be taken in each case from the same concrete sample; shrinkage tests will be considered a part of the normal compression tests for the project. 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157, modified as follows:

(a) Wet curing: Remove specimens from molds at an age of 23 hours ±1 hour after trial batching and immediately immerse in water at 70 degrees F ±3 degrees F for at least 30 minutes;

(b) Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");

(c) Then submerge in saturated limewater, at 73 degrees F ±3 degrees F, for 7 days;

(d) Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);

(e) Calculate expansion (base length expressed as a percentage of original length);

(f) Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 degrees F, ±3 degrees F and 50 percent ±4 percent relative humidity, for the remainder of the test.

(g) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at "zero" days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage.

(h) Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

4. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory employed and paid by the District in accordance with Section 01454, Testing Laboratory Services, when requested by District Engineer.

   a. Checking of batching and mixing operations.

   b. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.

   c. Molding and testing reserve 7-day cylinders or field cylinders.

   d. Conducting additional field tests for slump, concrete temperature and ambient temperature.

   e. Alkalinity Tests: For concrete used in sanitary structures, one test for each structure. Perform alkalinity tests on concrete covering reinforcing steel on the inside of the pipe or structure in accordance with "Encyclopedia of Industrial Chemical Analysis," Vol. 15, page 230.

5. Contractor shall provide the following testing and quality control services:

   a. Employ an independent commercial testing laboratory, acceptable to District, to prepare and test design mix for each class of concrete for which material source has been changed.

   b. Notify commercial testing laboratory employed by District 24 hours prior to placing concrete.

6. Testing of deficient concrete in place:

   a. When averages of three consecutive strength test results fail to equal or exceed specified strength, or when any individual strength test result falls

below specified strength by more than 500 psi, strength of concrete shall be considered potentially deficient and core testing, structural analysis or load testing may be required by Project Manager.

b. When concrete in place proves to be deficient, Contractor shall pay costs, including costs due to delays, incurred in providing additional testing and analysis services provided by the District Engineer, or the independent commercial testing laboratory selected by the District.

c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the District.

d. Core Tests:

(1) Obtain and test cores in accordance with ASTM C 42. Where concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before test; test dry. Where concrete in structure will be more than superficially wet under service conditions, test cores after moisture conditioning in accordance with ASTM C 42.

(2) Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by Project Manager so as to least impair strength of structure. When, before testing, one or more cores shows evidence of having been damaged during or after removal from structure, replace the damaged cores.

(3) Concrete in area represented by core test will be considered adequate when average strength of cores is equal to at least 85 percent of specified strength, and when no single core is less than 75 percent of specified strength.

e. Structural Analysis: When core tests are inconclusive or impractical to obtain, Project Manager may perform additional structural analysis at Contractor's expense to confirm safety of structure.

f. Load Tests: When core tests and structural analysis do not confirm safety of structure, load tests may be required, and their results evaluated, in accordance with ACI 318.

g. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by Project Manager to determine relative strengths at various locations in structure, to evaluate concrete strength in place, or for selecting areas to be cored. However, such tests, unless properly calibrated and correlated with other

test data, shall not be used as basis for acceptance or rejection of structure's safety.

1.07 STORAGE AND HANDLING OF MATERIALS

A. Cement: Store cement in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set. When there is any doubt as to expansive potential of shrinkage-compensating cements because of method or length of storage and exposure, laboratory test cement before use.

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 3 feet in thickness. Complete each layer before next is started.

C. Fine Aggregate: Before using, allow fine aggregate to drain until uniform moisture content is reached.

D. Admixtures: Store admixtures to avoid contamination, evaporation or damage. For those used in 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.

E. Lightweight Aggregates: Uniformly predampen lightweight aggregates as necessary to prevent excessive variations in moisture content. Allow predampened aggregates to remain in stockpiles, under continuous fog spray, for minimum of 24 hours before use. Provide adequate drainage in stockpile areas to eliminate excess water and accumulation of contaminated fines.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement:

1. Use same brand of cement used in concrete mix design. Use only one brand of each type in each structure, unless otherwise indicated on Drawings.

2. Portland Cement: ASTM C 150, Type I or Type II, gray in color. Use Type III only when specifically authorized by District Engineer in writing. Use Type II, including the requirements of Table 2, in construction of liquid-containing structures and cooling towers, unless shown otherwise on Drawings.

B. Admixtures:

1. Do not use calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions.

2. Air-Entraining Admixtures: ASTM C 260, compatible with other admixtures used.

3. Chemical Admixtures: Polymer type, nonstaining, chloride-free admixtures conforming to ASTM C 494, Type A, C, D or E.

4. High-Range Water Reducer (Superplasticizer): ASTM C 494, Type F or G, compatible with and by the same manufacturer as other admixtures.

C. Mixing Water: Use clean, potable water, free from harmful amounts of oils, acids, alkalis or other deleterious substances, meeting requirements of ASTM C 94.

D. Aggregates: Use coarse aggregate from only one source, and fine aggregate from only one source, for exposed concrete in any single structure.

1. Coarse Aggregate: Gravel, crushed gravel or crushed limestone conforming to ASTM C 33.

2. Fine Aggregate: Natural sand complying with ASTM C 33.

3. Limestone aggregate shall conform to ASTM C 33 and the following additional requirements: Clean, hard, strong and durable particles free of chemicals and coatings of silt, clay, or other fine materials that may affect hydration and bond of cement paste. Select crushed limestone: High-calcium limestone (minimum 95 percent $CaCO_3$ and maximum 3.5 percent $MgCO_3$) with maximum Los Angeles Abrasion loss of 38 percent, when tested in accordance with ASTM C 131 or ASTM C 535. Test aggregate for soundness in accordance with ASTM C 88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test.

4. Maximum size of coarse aggregate:

a. Normal weight concrete, except as noted below: 1-1/2 inches.

b. Formed members 6 inches or less in least dimension: 1/5 least dimension.

c. Slabs: 1/3 depth of slab.

d. Drilled shafts: 1/3 clearance between reinforcing steel, but not greater than 3/4 inch.

e. Concrete fill, seal slabs and bonded concrete topping in clarifiers: 3/8 inch.

5. Coarse aggregate for lightweight concrete: ASTM C 330. Grading limits: 3/4 inch to No. 4.

6. Abrasive Aggregate: Conform to requirements of Section 03350 - Concrete Finishing.

E. Calcium Chloride: Not permitted.

F. Evaporation Retardant: Masterbuilders "Confilm", Euclid "Eucobar", or equal.

G. Miscellaneous Materials:

1. Bonding Agent: Two-component modified epoxy resin.

2. Vapor barrier: 6 mil clear polyethylene film of type recommended for below-grade aplication.

3. Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.01 CONCRETE MIX

A. Objective: Select proportions of ingredients to produce concrete having proper placability, durability, strength, appearance, and other specified properties.

B. Mix Design: Employ and pay an independent commercial testing laboratory, acceptable to District, to prepare and test mix designs for each type of concrete specified. Proportion mix design ingredients by weight. Submit mix designs and test results for approval.

1. During the trial batches, aggregate proportions may be adjusted by the testing laboratory using two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. Prepare trial batches using the aggregates, cement and admixtures proposed for the project. Make trial batches large enough to obtain 3 drying shrinkage test specimens and 6 compression test specimens from each batch. Shrinkage testing is required only for Class A and D concrete.

2. Determine compressive strength by testing 6-inch diameter by 12-inch high cylinders, made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Test 3 compression test cylinders at 7 days and 3 at 28 days. Average

compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall be not less than 125 percent of the specified compressive strength.

3. Perform sieve analysis of the combined aggregate for each trial batch according to of ASTM C 136. Report percentage passing each sieve.

4. In mix designs for Class A and D concrete, fine aggregate shall not exceed 41 percent of total aggregate by weight.

C. Shrinkage Limitations, Class A and D Concrete

1. Maximum concrete shrinkage for specimens cast in the laboratory from the trial batch: 0.036 percent as measured at 21-day drying age, or 0.042 percent at 28-day drying age. Use for construction only mix designs that meet trial batch shrinkage requirements. Shrinkage limitations apply only to Class A and D concrete.

2. Maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the District, for securing the specified shrinkage requirements: Changing the source or aggregates, cement or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or its effects.

D. Selecting Ingredient Proportions for Concrete:

1. Proportion concrete mix according to ACI 301, Chapter 3.

2. Establish concrete mix design by laboratory trial batches prepared by independent testing laboratory, or on basis of previous field experience in accordance with provisions of ACI 318, Item 5.3; however, minimum cement content for each class of concrete shall not be less than specified.

3. Concrete mix design data submitted for review shall have average 28-day compressive strength calculated in accordance with ACI 318, Item 5.3.2.1. When data is not available to determine standard deviation in accordance with ACI 318, Item 5.3.1, average 28-day strength of mix design shall conform to ACI 318, Table 5.3.2.2.

E. Water-Cement Ratios:

1. Maximum allowable water-cement ratios shall be as follows:
   a. Concrete for liquid-containing structures: 0.45.

   b. Concrete subjected to brackish water, salt spray or deicers: 0.40.

c. All other concrete: 0.55.

2. Superplasticizer may be added to maintain specified maximum water-cement ratios. Include free water in aggregate in water-cement ratio computations.

F. Adjustment of Mix Proportions: After sufficient data becomes available during construction, mix may be adjusted upon approval of Project Manager, in accordance with ACI 318, Item 5.5; however, minimum cement content for each class of concrete shall not be less than specified.

G. Entrained Air: Air-entrain all concrete except drilled shafts. Total air content in accordance with ASTM C 173: 4 to 6 percent.

H. Consistency, Workability, and Slump:

1. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods as specified, to give the desired strength, density, impermeability and smoothness of surface. Change the quantity of water as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. Determine the consistency of the concrete in successive batches by slump tests in accordance with ASTM C 143. Slumps shall be as follows:

Concrete Type	Minimum Slump	Maximum Slump
Portland Cement Concrete:	2"	4"
Concrete to be dosed with superplasticizer:	1"	3"
Normal Weight Concrete after dosing with superplasticizer:	4"	9"
Lightweight Concrete after dosing with superplasticizer:	4"	7"
Drilled Shaft Concrete:	4"*	8"

* Minimum slump where drilled shafts are cast in temporary casings: 5 inches.

2. Specified slump shall apply at time when concrete is discharged at job site. Perform slump tests to monitor uniformity and consistency of concrete delivered to job site; however, do not use as basis for mix design. Do not exceed water-cement ratios specified.

I. Admixtures: Proportion admixtures according to manufacturer's recommendations. Use of accelerator is permitted when air temperature is less than 40 degrees F. Use of retarder is permitted when temperature of placed concrete exceeds 65 degrees F.

J. High-Range Water Reducers (Superplasticizers): Use superplasticizer to improve workability of concrete or delay hydration of cement, in accordance with requirements and recommendations of product manufacturer and approved submittals.

K. Concrete Classification and Strength:

1. Strength: Conform to values for class of concrete indicated on Drawings for each portion of Work. Requirements are based on 28-day compressive strength. If high early-strength concrete is allowed, requirements are based on 7-day compressive strength.

2. Classification:

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard
Concrete for Structures Containing Water or Wastewater		
A	4000	564 (6 Sacks)
B	1500	329 (3-1/2 Sacks)
C	3000	470 (5 Sacks)
D	5000	658 (7 Sacks)
H	3000	611 (6-1/2 Sacks)
Concrete for Buildings, Slabs on Grade and Miscellaneous Structures		
AB	4000	Not Applicable
BB	1500	Not Applicable
CB	3000	Not Applicable
DB	5000	Not Applicable

Class (Light-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard
E	3000	Not Applicable
F	4000	Not Applicable
G	5000	Not Applicable

3. Maximum size aggregate for Class H concrete: 3/8 inch. Maximum size aggregate for all other normal-weight concrete: 1-1/2 inches, except as specified in Paragraph 2.01D.4.

4. When required strength is not obtained with minimum cement content as specified, add cement, lower water-cement ratio or provide other aggregates as necessary.

5. In addition to conforming to specified strength, lightweight concrete must be within specified unit weight limits. Maximum air-dry unit weight is 118 pounds per cubic foot; minimum is 110 pounds per cubic foot unless shown otherwise on

Drawings. Determine air-dry unit weight in accordance with ASTM C 567. Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.

L. Use of Classes of Concrete:

1. Use classes of concrete as indicated on the Drawings and in other specifications.

2. Liquid-containing structures: If not otherwise indicated, use the following classes for structures containing water or wastewater and for utility applications in the locations described:

   a. Class A: All reinforced concrete and where not otherwise defined.

   b. Class B: Unreinforced concrete used for plugging pipes, seal slabs, thrust blocks and trench dams, unless indicated otherwise.

   c. Class H: Fill and topping. Where concrete fill thickness exceeds 3 inches in the majority of a placement and is not less than 1.5 inches thick, Class A concrete may be used.

3. All other structures: If not otherwise indicated, use the following classes in the locations described:

   a. Class AB: All reinforced concrete and where not otherwise defined.

   b. Class CB: Duct banks; see Section 16402 - Underground Duct Banks for additional requirements.

   c. Class BB: Unreinforced concrete fill under structures.

2.02 MIXING NORMAL WEIGHT CONCRETE

A. Conform to ACI 301, Chapter 7.

B. Ready-Mixed Concrete:

1. Measure, batch, mix and transport ready-mixed concrete according to ASTM C 94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".

2. Provide batch tickets with information specified in ASTM C 94. Deliver batch ticket with concrete and give to District's on-site testing laboratory representative.

C. Batch Mixing at Site:

1. Mix concrete in batch mixer conforming to requirements of CPMB "Concrete Plant Mixer Standards". Use mixer equipped with suitable charging hopper, water storage tank and water measuring device. Batch mixer shall be capable of mixing aggregates, cement and water into uniform mass within specified mixing time, and of discharging mix without segregation. Operate mixer according to rated capacity and recommended revolutions per minute printed on manufacturer's rating plate.

2. Charge batch into mixer so some water will enter before cement and aggregates. Keep water running until one-fourth of specified mixing time has elapsed. Provide controls to prevent discharging until required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent addition of water during mixing. Discharge entire batch before mixer is recharged.

3. Mix each batch of 2 cubic yards or less for not less than 1 minute and 30 seconds. Increase minimum mixing time 15 seconds for each additional cubic yard or fraction of cubic yard.

4. Keep mixer clean. Replace pick-up and throw-over blades in drum when they have lost 10 percent of original depth.

D. Admixtures:

1. Charge air-entraining and chemical admixtures into mixer as solution using automatic dispenser or similar metering device. Measure admixture to accuracy within $\pm$ 3 percent. Do not use admixtures in powdered form.

2. Two or more admixtures may be used in same concrete, provided that admixtures in combination retain full efficiency and have no deleterious effect on concrete or on properties of each other. Inject admixtures separately during batching sequence.

3. Add retarding admixtures as soon as practicable after addition of cement.

E. Temperature Control:

1. When ambient temperature falls below 40 degrees F, keep as-mixed temperature above 55 degrees F to maintain concrete above minimum placing temperature.

2. When water or aggregate has been heated, combine water with aggregate in mixer before cement is added. Do not add cement to mixtures of water and aggregate when temperature of mixture is greater than 100 degrees F.

3. In hot weather, maintain temperature of concrete below maximum placing temperature. When necessary, temperature may be lowered by cooling ingredients, cooling mixer drum by fog spray, using chilled water or well-crushed ice in whole or part for added water, or arranging delivery sequence so

that time of transport and placement does not generate unacceptable temperatures.

4. Submit hot weather and cold weather concreting plans for approval.

2.03 MIXING LIGHTWEIGHT CONCRETE

A. Determining Absorption of Aggregates: Mixing procedures vary according to total absorption by weight of lightweight aggregates. Determine total absorption by weight before predamping in accordance with ASTM C 127.

B. Ten Percent or Less Absorption: Follow same requirements as for mixing normal-weight concrete when preparing concrete made with low-absorptive lightweight aggregates having 10 percent or less total absorption by weight. To be low-absorptive, aggregates must absorb less than 2 percent additional water in first hour after mixing.

C. More Than 10 Percent Absorption: Batch and mix concrete made with lightweight aggregates having more than 10 percent total absorption by weight, as follows:

1. Place approximately 80 percent of mixing water in mixer.

2. If aggregates are pre-dampened, add air-entraining admixture and all aggregates. Mix for minimum of 30 seconds, or 5 to 10 revolutions of truck mixer.

3. When aggregates have not been predampened, mix aggregates and water for minimum of 1 minute and 30 seconds, or 15 to 30 revolutions of truck mixer. Then add air-entraining admixture and mix for additional 30 seconds.

4. Then, in the following sequence, add specified or permitted admixtures (other than air-entraining agent), all cement, and mixing water previously withheld.

5. Complete mixing using procedures for normal-weight concrete.

2.04 MASS CONCRETE

A. Do not use high early-strength cement (Type III) or accelerating admixtures.

B. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.

C. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit revibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

2.05 EQUIPMENT

A. Select equipment of size and design to ensure continuous flow of concrete at delivery end. Conform to following equipment and operations requirements.

B. Truck mixers, agitators and manner of operation: Conform to ASTM C 94. Use of non-agitating equipment for transporting concrete is not permitted.

C. Belt conveyors: Configure horizontally, or at a slope causing no segregation or loss. Use approved arrangement at discharge end to prevent separation. Discharge long runs without separation into hopper.

D. Chutes: Metal or metal-lined (other than aluminum). Arrange for vertical-to-horizontal slopes not more than 1 to 2 nor less than 1 to 3. Chutes longer than 20 feet or not meeting slope requirements may be used if concrete is discharged into hopper before distribution.

E. Do not use aluminum or aluminum-alloy pipe or chutes for conveying concrete.

PART 3 EXECUTION

3.01 SPECIAL CONSIDERATIONS

A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by District Engineer. When shown or permitted, deposit concrete under water by methods acceptable to the District Engineer so fresh concrete enters mass of previously-placed concrete from within, causing water to be displaced with minimum disturbance at surface of concrete.

B. Protection from Adverse Weather: Unless adequate protection is provided or District Engineer's approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect Work.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. Earth Surfaces:

1. Under interior slabs on grade, install vapor barrier. Lap joints at least 6 inches and seal watertight with tape, or sealant applied between overlapping edges and ends. repair vapor barrier damaged during placement of reinforcing and inserts with vapor barrier material; lap over damaged areas at least 6 inches and seal watertight.

2. Other Earth Surfaces: Thoroughly wet by sprinkling prior to placing concrete, and keep moist by frequent sprinkling up to time of placing concrete thereon. Remove standing water. Surfaces shall be free from standing water, mud and debris at the time of placing concrete.

B. Construction Joints:

1. Definition: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been interrupted so that, in the judgment of the Project Manager, new concrete cannot be incorporated integrally with that previously placed.

2. Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, use forms or other means to shape the working face to secure proper union with subsequent work. Make construction joints only where acceptable to the Project Manager.

3. Preparation: Give horizontal joint surfaces a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, clean joint surfaces of laitance, loose or defective concrete and foreign material by hydroblasting or sandblasting (exposing aggregate), roughen surface to expose aggregate to a depth of at least 1/4 inch and wash thoroughly. Remove standing water from the construction joint surface before new concrete is placed.

4. After surfaces have been prepared cover approximately horizontal construction joints with a 3-inch lift of a grout mix consisting of Class A concrete batched without coarse aggregate; place and spread grout uniformly. Place wall concrete on the grout mix immediately thereafter.

C. Set and secure reinforcement, anchor bolts, sleeves, inserts and similar embedded items in the forms where indicated on Contract Drawings, shop drawings and as otherwise required. Obtain Project Manager's acceptance before concrete is placed. Accuracy of placement is the sole responsibility of the Contractor.

D. Place no concrete until at least 4 hours after formwork, inserts, embedded items, reinforcement and surface preparation have been completed and accepted by the Project Manager. Clean surfaces of forms and embedded items that have become encrusted with grout or previously-placed concrete before placing adjacent concrete.

E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate). Coat joint surface with epoxy bonding agent following manufacturer's written instructions, unless indicated otherwise. Unless noted otherwise, this provision does not apply to vertical wall joints where waterstop is installed.

F. Protection from Water: Place no concrete in any structure until water entering the space to be filled with concrete has been properly cut off or diverted and carried out of the forms, clear of the work. Deposit no concrete underwater. Do not allow still water to rise on any concrete until concrete has attained its initial set. Do not allow water to flow over the surface of any concrete in a manner and at a velocity that will damage the surface finish of the concrete. Pumping, dewatering and other necessary operations for removing ground water, if required, are subject to Project Manager's review.

G. Corrosion Protection: Position and support pipe, conduit, dowels and other ferrous items to be embedded in concrete construction prior to placement of concrete so there is at least a 2 inch clearance between them and any part of the concrete reinforcement. Do not secure such items in position by wiring or welding them to the reinforcement.

H. Where practicable, provide for openings for pipes, inserts for pipe hangers and brackets, and setting of anchors during placing of concrete.

I. Accurately set anchor bolts and maintain in position with templates while they are being embedded in concrete.

J. Cleaning: Immediately before concrete is placed, thoroughly clean dirt, grease, grout, mortar, loose scale, rust and other foreign substances from surfaces of metalwork to be in contact with concrete.

3.03 HANDLING, TRANSPORTING AND PLACING CONCRETE

A. Conform to applicable requirements of Chapter 8 of ACI 301 and this Section. Use no aluminum materials in conveying concrete.

B. Rejected Work: Remove concrete found to be defective or non-conforming in materials or workmanship. Replace rejected concrete with concrete meeting requirements of Contract Documents, at no additional cost to the District.

C. Unauthorized Placement: Place no concrete except in the presence of the Project Manager. Notify the Project Manager in writing at least 24 hours before placement of concrete.

D. Placement in Wall Forms:

1. Do not drop concrete through reinforcing steel.

2. Do not place concrete in any form so as to leave an accumulation of mortar on form surfaces above the concrete.

3. Pump concrete or use hoppers and, if necessary, vertical ducts of canvas, rubber or metal (other than aluminum) for placing concrete in forms so it reaches the place of final deposit without separation. Free fall of concrete shall not exceed 4 feet below the ends of pump hoses, ducts, chutes or buggies. Uniformly distribute concrete during depositing.

4. Do not displace concrete in forms more than 6 feet in horizontal direction from place where it was originally deposited.

5. Deposit in uniform horizontal layers not deeper than 2 feet; take care to avoid inclined layers or inclined construction joints except where required for sloping members.

6. Place each layer while the previous layer is still soft. Rate of placement shall not exceed 5 feet of vertical rise per hour.

7. Provide sufficient illumination in form interior so concrete at places of deposit is visible from the deck or runway.

E. Conveyors and Chutes: Design and arrange ends of chutes, hopper gates and other points of concrete discharge in the conveying, hoisting and placing system so concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyors, if used, shall be of a type acceptable to the District Engineer. Do not use chutes longer than 50 feet. Slope chutes so concrete of specified consistency will readily flow. If a conveyor is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyors and chutes shall be covered.

F. Placement of Slabs: In hot or windy weather, conducive to plastic shrinkage cracks, apply evaporation retardant to slab after screeding in accordance with manufacturer's instructions and recommendations. Do not use evaporation retardant to increase water content of the surface cement paste. Place concrete for sloping slabs uniformly from the bottom of the slab to the top, for the full width of the placement. As work progresses, vibrate and carefully work concrete around slab reinforcement. Screed the slab surface in an up-slope direction.

G. Concrete Temperature: When placed, not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick, nor less than 50 degrees for all other sections. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

H. Cold Weather Placement: Conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.

1. Remove snow, ice and frost from surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. Warm reinforcement and embedded items to above 32 degrees F prior to concrete placement.

2. Maintain concrete temperature above 50 degrees F for at least 3 days after placement.

3.04 PUMPING OF CONCRETE

A. If pumped concrete does not produce satisfactory results, in the judgment of the Project Manager, discontinue pumping operations and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment: Use a 2-cylinder pump designed to operate with only one cylinder if one is not functioning, or have a standby pump on site during pumping.

C. The minimum hose (conduit) diameter: Comply with ACI 304.2R.

D. Replace pumping equipment and hoses (conduits) that do not function properly.

E. Do not use aluminum conduits for conveying concrete.

F. Field Control: Take samples for slump, air content and test cylinders at the placement (discharge) end of the line.

3.05 CONCRETE PLACEMENT SEQUENCE

A. Place concrete in a sequence acceptable to the Engineer. To minimize effects of shrinkage, place concrete in units bounded by construction joints shown. Place alternate units so each unit placed has cured at least 7 days for hydraulic structures, or 3 days for other structures, before contiguous unit or units are placed, except do not place corner sections of vertical walls until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for other structures.

B. Level the concrete surface whenever a run of concrete is stopped. To ensure straight and level joints on the exposed surface of walls, tack a wood strip at least 3/4-inch thick to the forms on these surfaces. Carry concrete about 1/2 inch above the underside of the strip. About one hour after concrete is placed, remove the strip, level irregularities in the edge formed by the strip with a trowel and remove laitance.

3.06 TAMPING AND VIBRATING

A. Thoroughly settle and compact concrete throughout the entire depth of the layer being consolidated, into a dense, homogeneous mass; fill corners and angles, thoroughly embed reinforcement, eliminate rock pockets and bring only a slight excess of water to the exposed surface of concrete during placement. Use ACI 309R Group 3 immersion-type high-speed power vibrators (8,000 to 12,000 rpm) in sufficient number and with sufficient (at least one) standby units. Use Group 2 vibrators only when accepted by the District Engineer for specific locations.

B. Use care in placing concrete around waterstops. Carefully work concrete by rodding and vibrating to make sure air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, work concrete under waterstops by hand, making sure air and rock pockets have been eliminated. Give concrete surrounding the waterstops

additional vibration beyond that used for adjacent concrete placement to assure complete embedment of waterstops in concrete.

C. Concrete in Walls: Internally vibrate, ram, stir, or work with suitable appliances, tamping bars, shovels or forked tools until concrete completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously-placed layers have been so worked. Provide vibrators in sufficient numbers, with standby units as required, to accomplish the results specified within 15 minutes after concrete of specified consistency is placed in the forms. Keep vibrating heads from contact with form surfaces. Take care not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 PLACING MASS CONCRETE

A. Observe the following additional restrictions when placing mass concrete.

1. Use specified superplasticizer.

2. Maximum temperature of concrete when deposited: 70 degrees F.

3. Place in lifts approximately 18 inches thick. Extend vibrator heads into previously-placed layer.

3.08 REPAIRING SURFACE DEFECTS AND FINISHING

A. Subject to approval by the District Manager and Engineer.

3.09 CURING

A. No formwork shall be removed no earlier than 3 days following a pour and is subject to approval by the District Engineer prior to stripping the forms.

3.10 PROTECTION

A. Protect concrete against damage until final acceptance by the District.

B. Protect fresh concrete from damage due to rain, hail, sleet or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the District Engineer.

END OF SECTION

Section 03315

CONCRETE FOR UTILITY CONSTRUCTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices. 1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structure. 2. Obtain services of and pay for certified testing laboratory to prepare design mixes. 3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

E. ACI 308 - Standard Practice for Curing Concrete.

F. ACI 309R - Guide for Consolidation of Concrete.

G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.

H. ACI 315 - Details and Detailing of Concrete Reinforcement.

I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.

J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.

K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete

Reinforcement.

L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.

Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.

R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

S. ASTM C 33 - Standard Specification for Concrete Aggregates.

T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.

X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

Y. ASTM C 150 - Standard Specification for Portland Cement.

Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

FF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.

GG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

HH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

II. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.

JJ. CRSI MSP-1 - Manual of Standard Practice.

KK. RSI - Placing Reinforcing Bars.

LL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

MM. NRMCA - Concrete Plant Standards.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit proposed mix design and test data for each type and strength of concrete in Work.

C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Project Manager.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.05 HANDLING AND STORAGE

A. Cement: Store cement off of ground in well-ventilated, weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

PART 2 P R O D U C T S

2.01 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Project Manager; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.

2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of Na O + 0.658K 0. 2 2

B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

C. Aggregate:

1. Coarse Aggregate: ASTM C 33. Unless otherwise indicated, use following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

2. Fine Aggregate: ASTM C 33. 3. Determine potential reactivity of fine and coarse aggregate in accordance with Appendix to ASTM C 33.

D. Air Entraining Admixtures: ASTM C 260.

E. Chemical Admixtures:

1. Water Reducers: ASTM C 494, Type A.

2. Water Reducing Retarders: ASTM 494, Type D.

3. High Range Water Reducers (Superplasticizers): ASTM C 494, Types F and G.

F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.

G. Reinforcing Steel:

1. Use new billet steel bars conforming to ASTM A 615, ASTM A 767, or ASTM A 775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.

2. Where shown, use welded wire fabric with wire conforming to ASTM A 185 or ASTM A 884. Supply gauge and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.

3. Wire: ASTM A 82. Use 16 1/2 gauge minimum for tie wire, unless otherwise indicated.

H. Fiber:

1. Fibrillated Polypropylene Fiber:

   a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.

   b. Physical Properties:

      1. Material: Polypropylene

      2. Length: 1/2 inch or graded

      3. Specific Gravity: 0.91

   c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.

2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.

   a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.

   b. Physical Properties

      1. Material: Steel

      2. Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1

      3. Specific Gravity: 7.8

      4. Tensile Strength: 40-400 ksi.

      5. Young's Modulus: 29,000 ksi

6. Minimum Average Tensile Strength: 50,000 psi

7. Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking

I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

2.02 FORM WORK MATERIALS

A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.

C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.03 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.04 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.

B. Measure water and liquid admixtures by volume.

2.05 DESIGN MIX

A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Project Manager for review.

C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Project Manager.

D. Classification:

Class	Type	MINIMUM COMPRESSIVE STRENGTH (LBS/SQ IN.)		MAXIMUM W/C RATIO	AIR CONTENT (PERCENT)	CONSISTENCY RANGE IN SLUMP (INCHES)
		7-DAY	28-DAY			
A	Structural	3200	4000	0.45	4± 1	2 TO 4*
B	Pipe Block Fill, Thrust Block	---	1500	---	4± 1	5 to 7
*When ASTM C 494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.						

E. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.

F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.

G. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.06 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.

B. Flat Strip and Center-Bulb Waterstops:

1. Thickness: not less than 3/8 inch

2. Acceptable Manufacturers:

   a. Kirkhill Rubber Co., Brea, California

   b. Water Seals, Inc., Chicago, Illinois

   c. Progress Unlimited, Inc., New York, New York

   d. Greenstreak Plastic Products Co., St. Louis, Missouri

   e. Approved equal.

2.07 RESILIENT WATERSTOP

A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.

B. Bentonite Waterstop:

1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.

2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.

3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch

4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Preformed plastic adhesive waterstop at least 2 inches in diameter.

2. Meets or exceeds requirements of Federal Specification SS-S-210A.

3. Supplied wrapped completely by 2 part protective paper.

4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.

5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.

6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop,

Synko- Flex Products, Inc.; or approved equal.

PART 3 EXECUTION

3.01 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back form work with sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by Project Manager, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

3.02 PLACING REINFORCEMENT

A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by Project Manager and obtain acceptance before concrete is placed.

B. Minimum spacing center-to-center of parallel bars: 2 1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.

C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.

D. Do not splice bars without written approval of Project Manager. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

3.03 EMBEDDED ITEMS

A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.

B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.04 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 though 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Project Manager before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.

E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

G. Hand-mix only when approved by Project Manager.

3.05 PLACING CONCRETE

A. Give sufficient advance notice to Project Manager (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to Project Manager's approval.

B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.

C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.

E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.06 WATERSTOPS

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous

for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

C. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.

2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.

3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Project Manager, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight- run portions of waterstop in forms.

D. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.

E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.

2. When requested by Project Manager, provide technical assistance by manufacturer's representative in field at no additional cost to City.

3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.

4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.

5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.

6. Bentonite Waterstop:

   a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.

   b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.

   c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

   d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy. e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.

7. Adhesive Waterstop:

   a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.

   b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.

   c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective

paper.

d. Do not remove protective paper until just before final form work completion. Place concrete immediately. The time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.07 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.

2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Project Manager. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.08 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Project Manager.

B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Rubbed Finish:

1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.

2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Project Manager. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.

2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

3.09 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.

B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Project Manager.

3.10 DEFECTIVE WORK

A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

3.11 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to

existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.

B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.

C. Apply wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Section 01454 - Testing Laboratory Services.

B. Unless otherwise directed by Project Manager, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements of ASTM C 1077.

1. Take concrete samples in accordance with ASTM C 172.

2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.

3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.

4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R. C. Test Cores: Conform to ASTM C 42.

C. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.

D. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of

structure which fail to develop required strength may be required by Project Manager, at no additional cost to City.

3.13 PROTECTION

A. Protect concrete against damage until final acceptance by City.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Project Manager.

END OF SECTION

Section 05501

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Bolts, anchors, nuts, sleeves, concrete anchors, scheduled items, and other miscellaneous metal items not specifically included under other sections of these specifications.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for metal fabrications under this section. Include payment as part of the Work in appropriate sections.

2. Refer to Section 01270 - Measurement and Payment.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REFERENCES

A. ASTM A 36 - Structural Steel.

B. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

C. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A 276 - Stainless and Heat-Resisting Steel Bars and Shapes.

F. ASTM A 307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

G. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

H. ASTM A 501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

I. ASTM F 593 - Stainless Steel Bolts, Hex Cap Screws, and Studs.

J. ASTM F 594 - Stainless Steel Nuts.

K. AWS A 2.0 - Standard Welding Symbols.

L. AWS D 1.1 - Structural Welding Code.

M. SSPC - Steel Structures Painting Council.

1.4 SUBMITTALS

A. Submit following Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate profiles, sizes, thickness, grade class, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A 2.0 welding symbols. Indicate net weld lengths.

D. Submit manufacturer's technical literature and test reports showing certified capacities for concrete anchors.

E. When foreign manufactured material is proposed for use, test material for conformance to ASTM Standards by a certified independent testing laboratory located in the United States. Certification from any other source outside the United States is unacceptable. Furnish copies of test reports to Project Manager for review. Do not begin fabrication until material has been approved. No additional payment will be made for thistesting.

1.5 QUALIFICATIONS

A. Prepare shop drawings under direct supervision of a professional Structural Engineer experienced in design of this work and licensed in the State of Texas.

B. Welders' Certificates: Submit following Section 01330 - Submittal Procedures, certifying welders employed on the Work, verifying AWS D1.1, Structural Welding Code, using procedures, materials and equipment of type required for this work. Welder must have been qualified or re-certified within the previous 12 months of date welding is being performed.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

1.7 DELIVERY AND STORAGE

A. Materials stored at project site: Store above ground on platforms, skids, or other supports. Keep free of dirt, mud, grease, or oil. Protect from corrosion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Shapes and Plate: ASTM A 36.

B. Stainless Steel Sections: ASTM A 276, Type 316 for non-welded items and Type 316L for welded items.

C. Steel Tubing: ASTM A 500 or ASTM A 501, Grade B.

D. Pipe: ASTM A 53, Grade B Schedule 40.

E. Bolts, Nuts, and Washers: ASTM A 307 galvanized to ASTM A 153 for galvanized components. Provide anchor bolts for all equipment and machinery when anchor bolts are not furnished by manufacturer. Conform anchor size, length, projection, etc., to requirements of equipment and machinery manufacturer. Provide templates to accurately position anchor bolts in forms.

F. Stainless Steel Bolts and Nuts: Bolts in accordance with ASTM F 593, Type 316; nuts in accordance with ASTM F 594, Type 316; UNC coarse threads.

G. Concrete Anchors: Concrete anchors are inserted into holes drilled in hardened concrete. Use one of the following types:

1. Adhesive Anchors: For concrete anchors which are submerged, in splash zones, in enclosed spaces over liquids, or anchoring vibrating equipment, use epoxy adhesive anchors. Adhesive anchors may be used at all locations where concrete anchors are required. Epoxy systems shall be Sika/FI System with Sikadur Injection Gel Epoxy, Master Builders Concresive Epoxy Cartridge Dispensing System and Concresive Paste LPL, or equal. Threaded rods shall be ASTM F 593, Type 316 studs. Where adhesive anchors, or connected metal, are exposed to direct sunlight, the anchors shall be certified to maintain at least 90 percent of their rated strength (tested at 73 F) when tested at 160 F.

2. Expansion Anchors: Where concrete anchors are indicated and adhesive anchors are not required, wedge type anchors made with ASTM A 276, Type 316 Stainless Steel shall be used. Anchors shall be KWIK Bolt II By Hilti, Inc., or equal.

H. Welding Materials: AWS D 1.1; type required for materials being welded.

I. Shop and Touch-Up Primer: Same manufacturer as protective coating; compatible with protective coating; applied in accordance with manufacturer's recommendation.

2.2 FABRICATION

A. Fit and shop-assemble in largest practical sections for delivery to site.

B. Fabricate items with joints tightly fitted and secured. Weld all shop connections except where welding is not practical, or unless otherwise shown on Drawings. Where screw bolts cannot be avoided, conceal fasteners where possible or countersink heads, screw up tight and nick threads to prevent loosening. Weld joints continuously except as shown on Drawings.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Welding shall conform to requirements of AWS D1.1, Structural Welding Code – Steel. Perform welding not governed by above in accordance with best modern practice for strength and durability.

2.3 FINISHES

A. Prepare surfaces to be primed in accordance with SSPC SP2.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Galvanize, after completion of welded fabrication, in accordance with ASTM A 123, structural steel members. Provide minimum 1.25 ounces per square foot galvanized coating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

C. Coat stainless steel threads with an anti-seizing compound prior to installing nuts.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D 1.1.

E. Obtain Project Manager approval prior to cutting or making adjustments in the field.

F. After erection, prime welds, abrasions, and surfaces not shop primed except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

3.5 COATING REPAIRS

A. Thoroughly clean field welds, abrasions, and damaged or defective areas of galvanized surfaces to remove all loose, cracked or bruised splatter coating. After surface is prepared, for galvanized surfaces apply two coats of galvanizing repair coating, as approved by Project Manager. Repair other coated surfaces in accordance with manufacturer's recommendations, unless otherwise specified.

END OF SECTION

SECTION 05530

ALUMINUM HANDRAILS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum mechanical sub-assembled guardrails and fittings.

B. Guardrail extension at new walkover.

1.02 REFERENCES

A. ASTM 6061-T6 and/or ASTM 6063-T6.

1.03 DESIGN REQUIREMENTS

A. Railing assembly and attachments to resist a concentrated load of 200 pounds applied in any direction at any point and a uniform load of 50 pounds per lineal foot applied to the horizontal rails in any direction. The loads shall not be applied simultaneously.

B. Space support posts 6 feet on center, maximum.

C. Guard Rail Extension - Space support posts 3 feet on center.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

PART 2 PRODUCTS

2.01 RAILING SYSTEM

A. Railings shall be constructed 1-1/2 inch diameter aluminum pipe schedule 40 with anodized satin finish. Finish to be clear anodized (0.7 mil). All fittings shall be extruded aluminum pre-engineered for railing application.

B. All railing shall be mounted to the side of concrete walkway surfaces using 1/2 inch diameter stainless steel expansion anchors.

C. All hardware used on the railing system shall be stainless steel.

D. All railing surfaces in contact with concrete or dissimilar metals shall receive one coat of zinc chromate.

E. All fittings shall be secured to the post and railing with #17 x 1" stainless steel set screws.

F. Railings shall be provided with two horizontal rails.

G. Toe boards shall be 4 inch extruded aluminum "Z" shape. Toe boards shall be connected to each railing post with a minimum of two fasteners in horizontal slotted holes. Splices shall be located and detailed to allow for thermal expansion and contraction.

H. Openings in rail shall be provided for access to gates and valves. Provide double strand 3/16 inch diameter stainless steel chain.

I. Provide expansion joints at maximum 24 ft centers using splice sleeves.

J. Manufacturer: Golden Railings, Inc., 15611 W. 6th. Avenue, Golden, CO 80401-5051 or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors and sockets required for connecting railings to concrete.

END OF SECTION

Section 09901

PROTECTIVE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparing surfaces, providing adequate conditions for proper workmanship, and furnishing and applying the protective coating materials required for metallic, concrete, masonry and plastic surfaces.

B. Color code painting of piping and piping identification signs and markers.

C. Refer to Section 09900 – Painting for Decorative and Protective Coatings to be used on Interior and Exterior Architectural Surfaces, such as wood, gypsum board and masonry.

D. Refer to Section 09971 – Painting and Protective Coatings for Potable Water Storage Tanks for painting and protective coatings to be used on potable water storage tanks.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for protective coatings unless specifically listed in Document 00410 – Bid Form. Include payment for protective coatings in unit prices for items to which coatings are applied.

2. Measurement for protective coatings, when included as a separate pay item, is on a square-foot basis for completed protective coating systems.

3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ANSI A13.1 – Color Schedule

B. ANSI/AWWA C213 – Fusion-bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

C. Federal Specification TT-P-28 – Paint, Aluminum, Heat Resisting 1200 degrees F

D. Federal Standard 595A – Federal Standard Colors

E. Military Specification DOD-P-23236 – Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast, Class 2

F. NSF Standard 61 – Drinking Water System Components – Health Effects

G. SSPC-PA 1 – Paint Application Specification No. 1 - Shop, Field and Maintenance Painting

H. SSPC-PA 2 – Paint Application Specification No. 2 – Measurement of Dry Paint Thickness with Magnetic Gages

I. SSPC-Paint 16 – Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

J. SSPC-SP 1 – Solvent Cleaning

K. SSPC-SP 2 – Hand Tool Cleaning

L. SSPC-SP 3 – Power Tool Cleaning

M. SSPC-SP 5/NACE 1 – White Metal Blast Cleaning

N. SSPC-SP 6/ NACE 3 – Commercial Blast Cleaning

O. SSPC-SP 7/NACE 4 - Brush-Off Blast Cleaning

P. SSPC-SP 10/NACE 2 – Near White Metal Blast Cleaning

Q. SSPC-SP 11 – Power Tool Cleaning to Bare Metal

R. SSPC-VIS 1-89 – Visual Standard for Abrasive Blast Cleaned Steel

S. SSPC-VIS 3 – Visual Standard for Power-and Hand-Tool Cleaned Steel

T. SSPC-QP 1 – Standard Procedure for Evaluating Qualifications of Painting Contractors

U. SSPC-QP 2 - Standard Procedure for Evaluating Qualifications of Painting Contractors to Remove Hazardous Paint

V. SSPC-SP12/NACE 5 – Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultrahigh-Pressure Water Jetting Prior to Recoating

1.04 DEFINITIONS

A. Paint, coatings, or finishes as used in this Section include surface treatments, emulsions, enamels, paints, epoxies, polyurethanes, acrylics, zincs, and other protective coatings with the exceptions of galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

B. DFT means minimum dry film thickness.

C. VOC means Volatile Organic Components

1.05 PERFORMANCE REQUIREMENTS

A. See the Drawings and other Specifications to determine how coatings under this Section will be applied. Paint or coat new and modified surfaces in conformance with this Section.

B. Coating system schedules summarize surfaces to be coated, required surface preparation, and coating systems to be applied. Coating notes on Drawings are used to show exceptions to schedules, to show or extend limits of coating systems, or to clarify or show details for application of coating systems.

C. Do not apply protective coatings to the following surfaces unless specifically named or shown to be coated:

1. Concrete
2. Stainless steel, bronze, or brass
3. Machined surfaces
4. Grease fittings
5. Glass
6. Equipment nameplates
7. Platform gratings, stair treads, door thresholds, and other walk surfaces
8. Galvanized steel electrical conduit and associated galvanized and factory-coated junction boxes and electrical panels
9. Galvanized surfaces inside buildings and not exposed to view
10. Manhole and valve covers and rings, storm water inlet gratings, covers, and frames

D. Provide decorative and protective coatings for interior architectural surfaces such as wood, gypsum board, and masonry in accordance with Section 09900 – Painting.

1.06 SUBMITTALS

A. Make submittals in accordance with Section 01330 – Submittal Procedures.

B. Submit the following information at least 10 days prior to protective coating work:

1. Coating Materials List: Eight copies of a coating materials list naming the manufacturer and the coating number, keyed to the coating systems described in this Section. Submit the list prior to or at the time of sample submittal.

2. Paint Manufacturer's Information: For each coating system to be used, submit

the following data:

a. Paint manufacturer's Product Data Sheet for each product proposed, including statements on the suitability of the material for the intended use.

b. Technical and performance information that demonstrates compliance with the system performance and material requirements.

c. Paint manufacturer's instructions and recommendations on surface preparation, application and curing.

d. Colors available for each product, where applicable.

e. Compatibility of shop and field applied coatings, where applicable.

f. Material Safety Data Sheets for each product used.

g. VOC of each paint or coating proposed, stated in grams per litre.

3. Samples

a. Submit color samples of paint, finishes, and other coating materials on 8-1/2 inch by 11-inch sheet metal or heavy cardstock. Have each sheet completely coated over its entire surface with one protective coating material, type, and color.

b. Provide two sets of color samples to match each color selected by the City Engineer from the manufacturer's standard color sheets. If custom-mixed colors are indicated, prepare color samples using color formulations prepared to match the color samples furnished by the City Engineer.

c. Submit one 15-pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.07 QUALIFICATIONS

A. Submit five (5) references which show that the painting Contractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting Contractor provided the protective coating. As an alternative, submit proof of certification in accordance with SSPC-QP 1.

B. For any project which involves removal or repair of lead based paints, submit proof of certification in accordance with SSPC-QP 2.

1.08 ENVIRONMENTAL RESTRICTIONS

A. Ventilate area where coating is being applied. Post and enforce NO SMOKING OR OPEN FLAME signs until coating has cured.

B. Provide lighting level of 80-foot candles (860 1x) measured mid-height at substrate surface.

C. Restrict worker access and construction traffic from area where coating is being applied or is curing.

D. Comply with City of Houston and all applicable OSHA confined space entry regulations including but not limited to OSHA Permit-Required Confined Space Standard 1910.146.

1.09 WARRANTY INSPECTION AND MAINTENANCE

A. Warranty Inspection:

1. A warranty inspection may be conducted during the eleventh month following completion of coating and painting. The Contractor and a representative of the coating material manufacturer must attend the inspection. At the option of the City, the City may be represented by a NACE certified coating inspector.

2. The City Engineer may, by written notice to the Contractor, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. Cancellation of the warranty inspection does not relieve the Contractor of his responsibilities under the Contract Documents.

3. Repair defective work discovered during the warranty inspection in accordance with these Specifications.

B. Extended Maintenance of Chemical Tank Lining Systems: Promptly repair defects in the chemical resistant sheet lining system for a period of 2 years after the lining has been placed into service. Such maintenance includes repair of the chemical tank and any equipment or facilities damaged by the corrosive action of the chemicals.

PART 2 PRODUCTS

2.01 COATINGS CRITERIA

A. Suitability: Use suitable coating materials as recommended by the manufacturer. Recommendations must be accompanied by test methods used to determine suitability and results of these tests.

B. Compatibility: In any coating system, use only compatible materials from a single manufacturer. Give particular attention to compatibility of primers, intermediate coats and finish coats. If necessary, apply a barrier coat or tie coat between existing prime coat and subsequent field coats to ensure compatibility.

C. Containers: Supply coating materials in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all plainly legible at the time of use.

D. Colors: Use colors and shades of colors of all coats of paint as indicated on the coating schedules or as selected by the City Engineer. Make each coat a contrasting shade to the previous and following coats to facilitate inspection of surface coverage of each coat. The City Engineer will select finish colors from the manufacturer's standard color samples.

E. Substitute or Equal Products:

1. To establish equality under Section 01630 – Product Substitution Procedures, furnish satisfactory documentation from the manufacturer of the proposed substitute product that the material meets the indicated requirements and is equivalent to or better in the following properties:

   a. Resistance to abrasion and physical damage.
   b. Resistance to chemical attack.
   c. Life expectancy.
   d. Ability to recoat in the future.
   e. Solids content by volume.
   f. Dry film thickness per coat.
   g. Compatibility with other coatings.
   h. Suitability for the intended service.
   i. Temperature limitations in service and during application.
   j. Type and quality of recommended undercoats and topcoats.
   k. Ease of application.
   l. Ease of repairing damaged areas.
   m. Stability of colors.
   n. VOC content expressed in grams per liter.

2. For substitutions, submit protective-coating materials which are standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, provide the City Engineer with the names of not less than 10 successful applications of the proposed manufacturer's products, which comply with these requirements. Applications must be in similar service environments to the job being contracted.

2.02 INDUSTRIAL COATING SYSTEMS

A. Material Sources: Each of the following manufacturers is capable of supplying many of the specified industrial coating materials. Manufacturers and specific paint designations (numbers) are listed to indicate the required type and quality of coating. Contractors are to base their bid on the use of products supplied by one of the named manufacturers. These named manufacturers are designated to establish a level of acceptable product quality or manufacturing experience and are not to be construed as the only manufacturers of products acceptable for use. Other manufacturers will be

considered on an individual basis, and may be submitted for consideration in accordance with Document 0700, Article 3.8, Product Options and Substitutions (excluding 3.8.3), Section 01330 – Submittal Procedures, Section 01630 – Products Substitution Procedures, and this Section.

1. AKZO/International Coatings
2. Ameron International
3. Carboline Coatings Company
4. Hempel Coatings USA, Inc.
5. ICI/Devoe Coatings
6. Sigma Coatings USA, Inc.
7. Tnemec Company
8. Sherwin Williams Co.

B. System 1 – Aliphatic Polyurethane Finish Coat: Use a two-component aliphatic acrylic polyurethane coating that provides superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering, and has a minimum solids content of 58 percent by volume. As primer, use a rust inhibitive 2- component epoxy coating with minimum solids content of 66 percent by volume.

1. Prime Coat:

   a. DFT = 4-6 mils (100-150 microns).

   b. Products: Ameron 385, Carboline 893, Tnemec 69, VyGuard V75, SW Macropoxy 646 FC Epoxy, or equal.

2. Finish Coats (one or more):

   a. DFT = 2-4 mils (50-100 microns).

   b. Products: Ameron 450 GL, Carboline 134 HG, Tnemec 74, VyGuard V54, Sherwin Williams Hi-Solids Polyurethane, or equal.

3. Total System = 6-10 mils (150-250 microns).

4. Apply more than one finish coat as necessary to produce a finish with uniform color and texture.

C. System 2 – Inorganic Zinc/Epoxy Polyurethane: For prime coat, use a 2-component water or solvent-based inorganic zinc silicate which contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. As intermediate coat, use a high-build, 2-component epoxy with a solids content of at least 70 percent by volume. For finish coat, use a 2-component aliphatic acrylic or polyester polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and has a minimum solids content of 58 percent by volume.

1. Prime Coat:

   a. DFT = 2.5-4.0 mils (65-100 microns).

   b. Products: Ameron Dimetcote 21-5 or 21-9, Carbozinc 11 or D7WB, VyGuard 13F6 or 13F7, SW Zinc Clad II L.V. or equal.

2. Intermediate Coat:

   a. DFT = 4-6 mils (100-150 microns).

   b. Ameron 385, Carboline 893, VyGuard V75, or equal.

3. Finish Coats (one or more):

   a. DFT = 2.5 to 4.0 mils (65-100 microns).

   b. Ameron 450 GL, Carboline 134 HG, VyGuard V54, Sherwin Williams Hi-Solids Polyurethane, or equal.

4. Total System DFT = 9-14 mils (225-600 microns).

5. Apply intermediate coat in excess of 4 mils (100 microns) DFT using the mist coat/full coat technique to completely cover the inorganic zinc primer and prevent bubbling of the epoxy or polyurethane finish coat.

6. Apply more than one finish coat as necessary to produce a finish with uniform color and texture.

7. If inorganic zinc primer is used as a pre-construction or shop-applied primer, and there are damaged or uncoated areas, spot blast the damaged areas with abrasive to an SSPC-SP 10 Near White Metal Standard and then coat with the specified material.

D. System 3 – Inorganic Zinc: Use a 2-component water-based inorganic zinc silicate which contains at least 85 percent of metallic zinc by weight in the dried film.

1. Prime Coat and Finish Coat (one).

   a. DFT = 2.5 to 4.0 mils (65-100 microns).

   b. Products: Ameron Dimetcote 21-5, Carbozinc D7WB, VyGuard 13F6 or 13F7, S.W. Zinc Clad XI, or equal.

2. Total System DFT = 2.5 to 4.0 mils (65-100 microns).

E. System 4 – Acrylic Latex: Use a single component, water-based acrylic latex with a

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fungicide additive having a minimum solids content of 35 percent by volume. Apply a prime coat as recommended by manufacturer. Select coating material, which is available in ANSI safety colors.

1. Prime Coat

   a. DFT = 2-3 mils (50-75 microns).

   b. Products: Carboline D3358, Ameron 148, Hemucryl 1803, Sherwin Williams DTM Primer/Finish.

2. Finish Coats (2 or more):

   a. DFT = 6-8 mils (150-200 microns).

   b. Products: Carboline D3359, Ameron 220, Hemucryl 4803, Sherwin Williams DTM Acrylic Coating or equal.

3. Total System DFT = 8-11 mils (200-275 microns).

F. System 5 – Epoxy: Use a two-component, rust inhibitive, polyamide-cured epoxy coating material with a recoatable finish that is available in a wide selection of colors. Use a coating with a minimum solid content of 66 percent by volume and resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.

1. Prime Coat:

   a. DFT = 3-5 mils (75-125 microns).

   b. Products: Ameron 385PA, Carboline 193, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.

2. Prime Coat (where shop applied):

   a. DFT = 3-5 mils (75-125 microns).

   b. Products: Ameron 370, Carboline 193, Tnemec 161, VyGuard V75, Sherwin Williams Recoatable Epoxy Primer, or equal.

3. Finish Coats (2 or more):

   a. DFT = 5- 7 mils (125-175 microns).

   b. Products: Ameron 385, Carboline 893, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC,or equal.

4. Total System DFT = 8-12 mils (200-300 microns).

G. System 6 – Aliphatic Polyurethane, Fiberglass: Use a two-component aliphatic polyurethane coating material with superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. Use a primer, tie coat, or mist coat as recommended by the manufacturer.

1. Prime Coat (Tie Coat): Ameron 385, Carboline 893, Tnemec P66, VyGuard V75, Macropoxy 646 FC, or equal.

2. Finish Coats (2 or more):

a. DFT = 2-4 mils (50-75 microns).

b. Products: Ameron Amershield, Carbothane 134 HG, Tnemec 74, VyGuard V54, or equal.

H. Section 7 – Alkyd Enamel: Use a high quality, gloss, or semi-gloss, medium long oil alkyd finish with a minimum solids content of 49 percent by volume. Apply primer as recommended by manufacturer.

1. Prime Coat:

a. DFT = 2-3 mils (50 to 75 microns).

b. Products: Ameron 5105, Carboline AD29, Tnemec P4-55, VyGuard 13R29, kem Kromik Universal, or equal.

2. Finish Coats (2 or more):

a. DFT = 2-4 mils (50-75 microns).

b. Products: Ameron 5401HAS, Carboline GP62, Tnemec 2H, VyGuard V20, Sherwin Williams Indusrial Enamel, or equal.

3. Total System DFT = 4-7 mils (100-175 microns).

I. System 8 – Aluminum Metal Isolation: Use one coat of a high-build polyamide epoxy paint.

1. Products: Tnemec P66, Ameron 385, Carboline 893, Tnemec P66, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.

2. Total System DFT = 6-8 mils (150-200 microns).

J. System 9 – Aluminum Silicone Resin: Use an aluminum silicone resin material suitable for a service temperature of up to 1000 degrees F (538 degrees C). Coating must comply with Federal Specification DOD-P-28.

1. Prime Coat and Finish Coat (2 or more):

a. DFT = 2-4 mils (50-100 microns)

b. Products: Tnemec 39-1061, Ameron 878, Carboline 4631, VyGuard V437A1, Sherwin Williams Steel Master 9500, or equal

c. Total System DFT = 2-4 mils (50-100 microns)

K. System 10 – Zinc Rich Epoxy: Use a polyamide Epoxy resin material that contains at least 76 percent zinc in the dried film.

1. Prime Coat and Finish Coat (2 or more):

a. DFT = 3-5 mils (75-125 microns)

b. Products: Ameron 68HS, Carboline 858, VyGuard 13F4, Sherwin Williams Zinc Clad III,or equal

c. Total System DFT = 3-5 mils (75-125 microns)

2.03 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. Material Sources: The manufacturers listed in this paragraph are materials, which satisfy the material descriptions of this paragraph and have a documented successful record for longterm submerged or sever service conditions. Proposed substitute products will be considered as indicated under paragraphs 2.01.5.

B. System 100 – Amine-Cured Epoxy: Use a high-build amine-cured epoxy with a solids content of at least 80 percent by volume. Use a coating suitable for long-term immersion in potable water and municipal wastewater. For potable water service, select a coating material listed in the NSF 61 Standard.

1. Prime Coat and Finish Coats (3 or more):

a. DFT = 16-19 mils (400 to 475 microns).

b. Products: Ameron Amercoat 395, Carboline 891, Tnemec 139, Sherwin Williams Tank Clad H.S,or equal.

2. For coating of valves and non-submerged equipment, DFT = 12-14 mils (300-350 microns).

C. System 101 – Polyamide Cured Epoxy: Use a high-build, polyamide epoxy resin with a solids content of at least 56 percent by volume. Use a coating suitable for long-term immersion in potable water or municipal wastewater. For potable water service, select a coating material listed under NSF 61 Standard.

1. Prime Coat and Finish Coats (3 or more):

a. DFT = 12-14 mils (300-350 microns).

b. Products: Tnemec 20, VyGuard 78PR, Sherwin Williams Macropoxy 646 NSF,or equal.

D. System 102 – Coal Tar Epoxy: Use a high-build, 2-component amine or polyamide-cured coal tar epoxy with a solids content of at least 68 percent by volume. Use a coating suitable for long-term immersion in wastewater or for coating of buried surfaces. Coating must conform to Mil Spec DOD-P-23236, or to SSPC Paint 16. Prime coats are for use as a shop primer only. Omit prime coat when both surface preparation and coating are performed in the field.

1. Prime Coat: DFT = 1.5-2.5 mils (38-65 microns).

a. Products: Ameron Amercoat 83HS, Tnemec P66, VyGuard V75, Sherwin Williams Copoxy Primer, or equal.

2. Finish Coats (2 or more):

a. DFT = 14-18 mils (350-450 microns).

b. Products: Ameron 78HB, Carbomastic 14, Tnemec 46H413, VyGuard 64, Sherwin Williams Targuard Coal Tar Epoxy,or equal.

c. Total System DFT = 15.5-20.5 mils (387-513 microns).

E. System 103 – Fusion Bonded Epoxy: Use a 100 percent powder epoxy applied in accordance with ANSI/AWWA C213, except prepare surface as specified in the coating system schedule in this Section. Apply the coating using the fluidized bed process.

1. Liquid Epoxy: For field repairs, use a 100 percent solids liquid epoxy as recommended by the powder epoxy manufacturer to provide a DFT of 15-17 mils (375-425 microns).

2. Powder Coating:

a. DFT = 15-17 mils (375-425 microns).
b. Products: Scotchkote 134 or 206N, Napgard 7-0008 or 7-2500, or equal.

c. Total System DFT = 15-17 mils (375-425 microns).

d. For coating of valves, DFT =11-12 mils (275-300 microns).

F. System 104 – Chemical Resistant Sheet Lining:

1. Materials: Use natural rubber, chlorobutyl rubber, ethylene propylene diene monomer (EPDM) rubber, chloroprene polymer (neoprene) rubber, or chlorosulfonated polyethylene (Hypalon) rubber sheet lining material. Submit shop drawings containing technical information that confirms the suitability of

the lining material system for long-term immersion in each chemical to be stored. Service temperatures are expected to be up to 150^0 F (65^0 C).

a. Neoprene Sheet Lining Material: Use a synthetic rubber formulated for steam curing at atmospheric pressure. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 59688, or equal.

b. Chlorobutyl Sheet Lining Material: Use a synthetic rubber formulated for steam curing at atmospheric pressure. Supply B.F. Goodrich compound 60924, or equal.

c. Natural Rubber (soft) Sheet Lining Material: Use a soft natural rubber formulated for steam curing at atmospheric pressure. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 83160, or equal.

d. Natural Rubber (hard) Sheet Lining Material: Use a hard, natural rubber resistant to oxidizing agents and formulated for autoclave curing. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 8631, or equal.

e. EPDM Sheet Lining Material: Use synthetic rubber suitable for use as a lining for 50 percent sulphuric acid solution and formulated for autoclave or steam curing under pressure.

f. Hypalon Sheet Lining Material: Use synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution.

2. Primers: Use primers, adhesives, activators, accelerators, and other necessary materials as recommended by the sheet material manufacturer.

3. Metal Surface Preparation: Prior to abrasive blast cleaning, prepare the base metal as required by the sheet lining material manufacturer's installation instructions. If the instructions differ from these specifications, provide the highest degree of cleaning and surface preparation required by either instructions or specifications. Perform abrasive blast cleaning in accordance with this section.

4. Installation: Install lining materials in accordance with the material manufacturer's written installation instructions. Line interior surfaces including piping, vents, fittings, flange faces, manhole covers, and blind flanges.

5. Testing: Test the lining system for holidays in accordance with this Section before and after curing.

6. Curing: Cure the lining system by steam using the time and temperature as required by the material manufacturer.

G. System 105 – Vinyl Ester: Use vinyl ester resin coating material with an inert flake pigment that is suitable for immersion service in 30 percent hydrochloric acid and 30 percent sulfuric acid solutions.

1. Coating (2 or more coats):

a. DFT = 40-45 mils (1000-1125 microns).

b. Products: Plasite 4100, Sherwin Williams Magnalux 304 FF,or equal.

c. Prime Coat: As recommended by the material manufacturer.

H. System 106 – 100% Solids Epoxy: Use a solventless epoxy resin coating suitable for severe service areas subject to splash, spillage or intermittent immersion in wide range of industrial chemicals and wastewater. Coating to resist normal abrasion from rolling vehicles.

1. Coating (2 or more coats):

a. DFT = 15-20 mils (325-500 microns).

b. Products: Ameron, Carboline, Sherwin CorCote HCR.

c. Prime Coat: As recommended by manufacturer.

I. System 107 – 100% solids Epoxy Sealer: Use a clear, unpigmented solventless epoxy suitable for application over marginal surfaces, including damp surfaces, tight rust and tight old coatings. Coating serves as primer for alkyd, acrylic, epoxy, and polyurethane finish coats.

1. Coating (1 coat only):

a. DFT = 1-2 mils (25-50 microns).
b. Products: ICI/Devoe 167 PrePrime, Carboline Rust Bond, Sherwin Williams 920 PrePrime, or equal.

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

A. Require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable to or associated with manufacturer's products.

B. For submerged and severe service coating systems, require the paint manufacturer to furnish the following services:

1. Provide at least 6 hours of on-site instruction on the proper surface preparation,

use, mixing, application, and curing of the coating systems.

2. Observe the start of surface preparation, mixing, and application and curing of the coating systems.

3. Provide the services of a NACE Certified Coating Inspector at all times during the surface preparation, mixing, application, curing and testing of all coatings applied in submerged or acid spill areas.

3.02 WORKMANSHIP

A. Use skilled craftsmen and experienced supervision. For all jobs involving lead based paint removal or repair, require the presence of a certified Competent Person, Lead per OSHA requirements.

B. Apply coating to produce an even film of uniform thickness. Give special attention to edges, corners, crevices, and joints. Ensure thorough cleaning and an adequate thickness of coating material. Apply coatings to produce finished surfaces free from runs, drips, ridges, waves, laps, brush marks, and variations in color, texture and finish. Effect complete hiding so that the addition of another coat would not increase the hiding. Give special attention to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas. Apply a brushed stripe coat to all edges and welds after priming submerged or severe service areas.

C. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, name plates on machinery, and other surfaces not to be painted. Provide drop cloths to prevent coating materials from falling on or marring adjacent surfaces. Protect the working parts of mechanical and electrical equipment from damage during surface preparation and coating operations. Mask openings in motors to prevent entry of coating or other materials.

D. Do not damage adjacent work during blast cleaning operations. Perform spray painting under carefully controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

E. Coordinate cleaning and coating so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.03 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation standards of the Society for Protective Coatings (SSPC) form a part of this Specification:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces by cleaning with solvent, vapor degreasing, emulsion or alkaline cleaners, or steam.

2. Hand Tool Cleaning (SSPC-SP2): Removal of all loose rust, loose mill scale,

loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by rotary or impact power tools, power wire brushing, or power abrading.

4. White Metal Blast Cleaning (SSPC-SP5/NACE 1): Removal of all visible oil, grease, soil, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): Removal of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except limit random staining to no more than 33 percent of each unit area of surface.

6. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Removal of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating, all of which are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.

7. Near-white Blast Cleaning (SSPC-SP10/NACE 2): Removal of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except limit random staining to no more than 5 percent of each unit area of surface.

3.04 METAL SURFACE PREPARATION (UNGALVANIZED)

A. Provide the minimum abrasive-blasted surface preparation as indicated in the coating system schedules at the end of this Section. Where there is a conflict between these specifications and the coatings manufacturer's printed recommendations for the intended service, the higher degree of cleaning applies.

B. Perform metal surface preparation in conformance with the current SSPC/NACE Standards and this Section. Blast cleaned surfaces must match standard samples in SSPC-VIZ 1.

C. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning using solving cleaning as per SSPC-SP1.

D. Round or chamfer sharp edges. Grind to smooth finish burrs, surface defects, and weld splatter prior to blast cleaning.

E. Select the type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. As abrasives for submerged and severe service coating systems use clean, hard, sharp cutting crushed slag. Do not use automated blasting systems and metal shot or grit for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned with hard, sharp-cutting slag.

F. Do not reuse abrasive except when an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, use clean, oil-free abrasives. In the abrasive mix, use at least 50 percent steel grit. Replenish abrasive mix with new shot/grit combination as necessary to maintain the anchor profile within 1/2 mil (13 microns) of the specified profile.

G. Comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. For air-blast cleaning, supply compressed air at adequate pressure from well-maintained compressors equipped with oil and a moisture separator which delivers oil and water-free air as checked with white blotter, white cloth, or plastic sheets at the beginning of each blasting sequence.

I. Clean surfaces of dust and residual particles of the cleaning operation using dry air-blast cleaning, vacuuming, or another approved method prior to painting. Vacuuming must be the final cleaning method immediately prior to painting areas that will go into submerged service.

J. In enclosed areas and other areas where dust may settle, vacuum the surface clean and wipe it with a tack cloth.

K. Remove damaged or defective coating by the specified blast or power tool cleaning to meet the clean surface requirements before recoating.

L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be in submerged service, then SSPC-SP2 – Hand Tool Cleaning or SSPC-SP3 – Power Tool Cleaning, may be used. If the coated area to be cleaned is less than 100 square feet, and will be in submerged service, then SSPC-SP11 Power Tool Cleaning to Bare Metal may be used.

M. Completely remove shop-applied coatings of unknown composition before the specified coatings are applied. Examine valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment for the presence of shop-applied temporary coatings. Completely remove temporary coatings by solvent cleaning per SSPC-SP1 method before starting abrasive blast cleaning. Alternate cleaning methods such as Baking Soda Blasting or Sponge Jet Blasting may be used as appropriate.

N. Use the solvent cleaning method (SSPC-SP1) to clean shop-primed equipment in the field before finish coats are applied.

3.05 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

A. For galvanized ferrous metal, use the alkaline cleaning method per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of protective coatings. Alternate methods with biodegradable surfactant type cleaners followed by fresh water washing may be used as appropriate.

B. Apply pretreatment coatings of surfaces in accordance with the printed recommendations of the coating manufacturer.

3.06 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS

A. Remove grease, oil, heavy chalk, dirt, or other contaminants by solvent or detergent cleaning prior to abrasive blast cleaning. Determine the generic type of the existing coatings by laboratory testing.

B. Provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, remove deteriorated coatings by abrasive blast cleaning to meet the requirements of SSPC-SP6 Commercial Blast Cleaning. Clean areas of tightly adhering coatings to meet the requirements of SSPC-SP7 Brush-Off Blast Cleaning, with the remaining thickness of pre-existing coating not to exceed 3 mils.

C. If coatings to be applied are not compatible with existing coatings, apply intermediate coatings conforming to the paint manufacturer's recommendation for the indicated coating system or completely remove the existing coating prior to abrasive blast cleaning. Make a small trial application for compatibility prior to painting large areas. Allow the trial application to cure for 7 days at 50° F (10° C) or higher before determining compatibility.

D. Completely remove coatings of unknown composition prior to application of new coatings.

E. Where specified or where job site conditions do not permit dry-abrasive blasting for industrial coating systems due to dust or air pollution considerations, water jetting or wet-abrasive blasting may be used. In both methods, use inhibitors approved by the manufacturer of the coating system, which will be applied over the cleaned area. Begin the coating application as soon as the surface has dried, and before the formation of any flash rusting. Perform water jetting with or without abrasive injection, as appropriate, to achieve the specified degree of surface cleanliness. Do not use water-jetting methods for submerged or severe-service coating systems, unless specified for that area.

3.07 PLASTIC, FIBERGLASS, AND NONFERROUS METALS SURFACE PREPARATION

A. Unless otherwise indicated, for equipment or parts of equipment which are not submerged in service, shop-prime, and then finish-coat in the field after installation. For methods, materials, application equipment, and other details of shop painting, comply with this Section. If the shop primer requires topcoating within a specified period of time, apply the finish coating in the shop and then touch-up the paint after installation.

B. Perform surface preparation and coating work in the field for equipment, or parts and

surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves.

C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switch gear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the required quality in the field. For such equipment, prime and finish-coat in the shop and touch-up in the field after installation. Use the identical material for touch-up that was used for shop painting. Require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. Submit the coating material product data sheet with the shop drawings for the equipment.

D. For certain small pieces of equipment, the manufacturer will have a standard coating system, which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

E. Protect shop-painted surfaces during shipment and handling. Protect surfaces with padding or blocking. Lift equipment with canvas or nylon slings. Before being topcoated, do not expose primed surfaces to the weather for more than 2 months or less when recommended by the coating manufacturer.

F. Repair damage to shop-applied coatings in accordance with this Section and the coating manufacturer's printed instructions.

G. Make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Submit copies of applicable coating manufacturer's product data sheets with equipment shop drawings.

3.08 APPLICATION OF COATINGS

A. Apply protective coatings to steel substrates in accordance with SSPC-PA1 – Paint Application Specification No. 1. Shop, Field and Maintenance Painting.

B. Inspect cleaned surfaces and each coat prior to succeeding coats. Schedule inspections with the City Engineer in advance.

C. Paint blast-cleaned ferrous metal surfaces before rusting or other deterioration of the surface occurs. Limit blast cleaning to only those surfaces that can be coated in the same working day unless the area to be coated is protected by humidity control equipment set to maintain humidity below 50 percent at all times.

D. Apply coatings in accordance with the manufacturer's instructions and this Section, whichever has the most stringent requirements.

E. Give special attention to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thickness is likely to occur. Use stripe painting by brush,

after application of the primer, for these areas.

F. Give special attention to materials, which will be joined so closely that proper surface preparation and application are not possible. Coat such contact surface prior to assembly or installation. Use only inorganic zinc primers on faying surfaces.

G. Apply finish coats, including touch-up and damage repair coats, in a manner which will present uniform texture and color-matched appearance.

H. Do not apply coatings under the following conditions:

1. Temperature outside of the manufacturer's recommended minimum and maximum range.

2. Dust or smoke laden atmosphere.

3. Substrate or air temperature less than 5° F (3° C) above the due point.

4. Air temperature is expected to drop below 40°F (14° C) or less than 5° F (3° C) above the dew point within 8 hours after application of the coating.

5. Wind conditions in excess of 15 MPH or dust laden.

I. Determine the dew point by use of a sling psychrometer in conjunction with the U.S. Department of Commerce, Weather Bureau psychometric tables.

J. For steel piping which will not be buried, have the surface abrasive blast cleaned and primed before installation.

K. Apply finish coats after concrete, masonry, and equipment installation is complete and the work areas are clean and dust free. Concrete must have cured for a minimum of 28 days @ 75° F (24° C) unless an approved epoxy sealer has been applied to green concrete within 12 hours of finishing the concrete.

3.09 CURING OF COATINGS

A. Maintain curing conditions in accordance with the recommendations of the coating material manufacturer and this Section, whichever is the most stringent. Complete curing before placing the coating systems into service.

B. In the case of enclosed areas, forced air ventilation using heated air may be required until the coatings have fully cured.

C. Forced air ventilation is required for the application and curing of coatings on the interior surfaces of enclosed hydraulic structures. During application and curing periods, continuously exhaust air from the lowest level of the structure using portable ducting to force air into all compartments and around baffles. After interior coating operations have been completed, provide a final curing period that meets the minimum temperature and time requirements of the manufacturer of the coating system being

applied, while operating the forced air ventilation system continuously.

3.10 SHOP AND FIELD INSPECTION AND TESTING

A. Give the City Engineer a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

B. Perform surface preparation and coating applications in the presence of the City Engineer, or his appointed NACE certified coating inspector, unless the City Engineer has granted prior approval to perform the work in their absence.

C. Inspection by the City Engineer or the NACE certified inspector, or the waiver of inspection of any particular portion of the work, does not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.

D. Erect and move scaffolding where requested by the City Engineer to facilitate inspection. Provide additional illumination to light areas to be inspected. Remove or grind smooth all scaffolding clips welded to the structure prior to surface preparation of the structure.

E. Until final acceptance of the coatings, furnish inspection devices in good working condition for the detection of holidays and measurement of dry-film thickness (DFT) of protective coatings. Make DFT gauges available for the City Engineer's use throughout the coating process until final acceptance of the coatings. Provide the services of a NACE certified coating inspector for all holiday detection work until the final acceptance of the coatings. Operate holiday inspection devices in the presence of the City Engineer.

F. Perform holiday tests on coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Perform holiday tests on surfaces coated with any of the submerged and severe service coating systems. Mark and repair or recoat areas which contain holidays in accordance with the coating manufacturer's printed instructions and then retest. DO NOT PERFORM HOLIDAY TESTING AFTER STRUCTURE HAS BEEN SUBMERGED.

1. Coatings with Thickness Exceeding 20 mils (500 microns): For surfaces having a total DFT exceeding 20 mils (500 microns); use a pulse-type holiday Detector such as Elcometer 136, or equal. Adjust and operate in accordance with NACE RP0188.

2. Coatings with Thickness of 20 mils (500 microns) or Less: For surfaces having a total DFT of 20 mils or less, use Elcometer 269 non-destructive type holiday detector, or equal. Instrument must operate at less than 75 volts. For thicknesses between 10 and 20 mils (250 and 500 microns), a non-sudsing type wetting agent such as Kodak Photo-Flo, or equal, may be added to the water prior to wetting the detector sponge. For submerged or severe service areas, the residue of the wetting agent must be removed with clean, fresh water prior to

application of any additional coats.

G. On ferrous metals, measure the DFT in accordance with SSPC-PA2 Measurement of Dry Film Thickness with magnetic gauges using either a pull-off type gauge (Elcometer 211) or constant pressure gauge (Elcometer 345F), or equal. Test each coat for the correct thickness. Calibrate the DFT gauge at the beginning of each workday or shift in accordance with the directions of the manufacturer of the gauge. Do not take measurements until at least 8 hours after coating application. On non-ferrous metals, measure the DFT with positive pressure eddy current gages (Elcometer 345N) or equal.

H. Evaluation of blast-cleaned surface preparation work will be based upon comparison with photographic samples contained in SSPC-VIZ 1.

I. Evaluation of surface profile will be based upon the use of TesTex pressure sensitive tapes.

3.11 PAINTING AND IDENTIFICATION OF PIPING

A. Painting and Color Coding:

1. Use colors and signs to identify all piping which is exposed to view in buildings or tunnels, above suspended ceilings or exposed above grade, and all outdoor piping. Identify each pipe by a color complying with the following schedule of colors and by applied markers.

2. Coat pipes with the number of coats and type of material specified. Base coats for pipeline painting may be a neutral color. Make each succeeding base coat a contrasting color. For the final coat, comply with the pipe identifying color schedule.

3. Apply pipe identification markers to exposed piping, except for the following pipe at wastewater lift stations:

a. Discharge piping for wastewater pumps.

b. Vent piping.

c. Any piping inside wet wells.

B. Pipe Identification Markers:

1. Identify all pipes with applied signs or markers at 15-foot centers, at both sides of penetrated walls or floors, adjacent to valves, at connected equipment, at branch fittings, and in congested pipe layouts.

a. Apply markers consisting of signs with legends as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS

(INCHES)	(INCHES)	(INCHES)
3/4 to 1- 1/4	8	1/2
1- 1/2 to 2- 3/8	8	3/4
2- 1/2 to 5- 7/8	12	1- 1/4
6 to 7- 7/8	12	1- 1/4
8 to 10	24	2- 1/2
Over 10	32	3- ½

b. As pipe markers, use semi-rigid outdoor grade acrylic plastic, Seton Name Plate Corp., SetMark, or equal. Use Type SNA for outside diameters 3/4 through 5- 7/8 inches and Type STR for 6-inch outside diameter or larger. For pipes less than 3/4-inch in diameter, use applied marker of brass identification tags 1-1/2 inches square with depressed letters 1/4-inch high, black-filled. Apply tightly to pipeline with metal or plastic straps.

C. Pipe Identification Color Schedule:

1. For wastewater facilities refer to current version of TCEQ chapter 217. For piping systems not found in TCEQ chapter 217, use the colors listed in the following pipe identification color schedule:

PIPE IDENTIFICATION COLOR SCHEDULE

PIPING SYSTEM	COLOR	FED. STD. NO.
Fire Mains	Red	11105
Oxygen	Orange	12246
Sodium Hypochlorite	Yellow	13655
Raw Polymer	Pink	11156
Diluted Polymer	Purple	17142
Natural Gas	Yellow	13655
Heating Water	Pink	11158
Domestic Hot	Light Pink	11668
Potable Water	Blue	15102
Non-Potable Water	White	17875
Instrument Air	Green	14187
Plant Air	Dark Green	14110
Raw Sewage	Gray	16473
Grit	Dark Gray	16187
Cyclone Return	Gray	16473
Classifier Return	Gray	16473
Heavy Solids	Dark Brown	10080
Return Sludge	Brown	10091
Waste Sludge	Yellow-Brown	10266
Scum	Light Brown	10334
Chilled Water Supply (CWS)	Blue-Green	14329
Chilled Water Return (CWR)	Blue-Green	14325
Condensing Water Supply (Cond-WS)	Light Green	14533
Condensing Water Return (Cond-WR)	Light Green	14533
Deionized Water (DW)	Light Blue	15526
Vacuum (Vac)	White	17875

PIPING SYSTEM	COLOR	FED. STD. NO.
Vent	Light Gray	16492

2. For pipe identification colors not listed above, follow American National Standard (ANSI A13.1-81) Color Schedule:

   a. Materials inherently hazardous, flammable or explosive; chemically active or toxic; extreme temperature or pressure; radioactive: Yellow Field with Black Letters.

   b. Material of inherently low hazard – liquid or liquid admixture: Green Field with White Letters; gas or gaseous admixture: Blue Field with White Letters.

   c. Fire quenching materials, water, foam, carbon dioxide, Halon, etc.: Red Field with White Letters.

3.12 COATING SYSTEM SCHEDULES – FERROUS METALS

A. Coating System Schedule, Ferrous Metal – Not Galvanized

SCHEDULE NO. AND APPLICATION	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
FM-1: Surfaces indoors and outdoors, exposed or covered, except those listed below.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(2) Inorganic zinc/epoxy/ polyurethane
FM-2: Surfaces in chlorination room, chlorine storage room, sodium hypochlorite storage room	Near White Metal blast cleaning SSPC-SP10/NACE 2	(100) Amine-cured epoxy
FM-3: Surfaces of pumps and equipment and other ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater; including surfaces lower than 2 feet above high-water level in hydraulic structures, and surfaces inside enclosed hydraulic structures, pump state wet wells, and vents (excluding shop-coated valves, couplings, and pumps).	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(100) Amine-cured epoxy
FM-4: Surfaces exposed to high temperature between 150^0 and 600^0 F (65^0 and 315^0 C).	Near White Metal blast cleaning SSPC-SP10/NACE 2	(3) Inorganic Zinc, water-based
FM-5: Surfaces exposed to high temperature between 600^0 and 1000^0 F.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(9) Aluminum silicon resin
FM-6: Where indicated, ferrous surfaces in water passages of valves 4-inch size and larger, exterior surfaces of submerged valves.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(101) Polyamide-cured epoxy

FM-7: Where indicated, ferrous surfaces in water passages of pumps which have discharge size of 4 inches or larger; exterior, submerged surfaces of pumps.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(101) Polyamide-cured epoxy
FM-8: Ferrous surfaces of sleeve couplings.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(103) Fusion-bonded epoxy
FM-9: Ferrous surfaces of sluicegates, flap gates, and shear gates, including wall thimbles.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(101) Polyamide-cured epoxy
FM-10: Structural steel, miscellaneous metal work, and supports for prefabricated metal buildings, not exposed to view in finished building.	Commercial Blast Cleaning (SSPC-SP6/NACE 3	(10) Zinc Rich Epoxy
FM-12: Ferrous metal exposed to view, inside and outside of buildings.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(2) Inorganic zinc/ epoxy/polyurethane
FM-13: Surfaces of indoor equipment not submerged.	Commercial Blast Cleaning SSPC-SP6/ NACE 3	(5) Epoxy, equipment
FM14: Exterior (exposed) surfaces shop-coated with fusion-bonded epoxy.	Light abrasive blast to roughen surface	(6) Aliphatic polyurethane

B. Coating System Schedule, Ferrous Metal – Galvanized: Apply pretreatment coatings, barrier coatings, or washes as recommended by the coating manufacturer.

SCHEDULE NO. AND APPLICATION	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTON
FMG-1: Exposed surfaces indoors and outdoors, except those listed below.	Alkaline cleaning SSPC-SP1	(1) or (4) Aliphatic Polyurethane, or Acrylic
FMG-2: Surfaces in chlorination room, chlorine storage room, and sodium hypochlorite storage room.	Alkaline Cleaning SSPC-SP1	(100) Amine-cured epoxy
FMG-3: Surfaces submerged in water or wastewater, including surfaces lower than 2 feet above high-water level and surfaces inside hydraulic structures and vents	Alkaline cleaning SSPC-SP1 followed by Brush-Off blast cleaning SSPC-SP7/ NACE 4	(100) Amine-cured epoxy
FMG-4: Surface exposed to view, inside and outside of building.	Alkaline Cleaning SSPC-SP1	(1) or (4) Aliphatic polyurethane, or Acrylic

C. Coating System Schedule, Interior Surface of Welded Steel Tanks: Coat interior surfaces, including tank nozzles, manholes, nozzle necks, and flange faces. For steel tank exterior coating systems, see paragraph 3.15.1, Coating System Schedule, Ferrous Metal – Not Galvanized.

PRODUCT STORED	SURFACE PREPARATION	SYSTEM NO. /DESCRIPTION

Zinc Orthophosphate	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Liquid Alum	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Polymer	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Sodium Bisulfite	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Ferric Chloride	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (hard)
Aqueous Ammonia	White metal blast cleaning SSPC-SP5/NACE1	(104) Chlorobutyl rubber
Caustic Soda	Commercial Blast Cleaning SSPC-SP6/NACE 3	No Coating
Sodium Hypochlorite	White metal blast cleaning SSPC-SP5/NACE1	(104) Chlorobutyl Rubber
Sulfuric Acid (max. 45% concentration)	White metal blast cleaning SSPC-SP5/NACE1	(107) Hypalon
Sulfuric Acid (above 40% concentration)	White metal blast cleaning SSPC-SP5/NACE1	(107) Viton
Hydrofluosilicic Acid	White metal blast cleaning SSPC-SP5/NACE1	(107) Chlorobutyl Rubber
Water, Potable Water, Utility Water	White metal blast cleaning SSPC-SP5/NACE1	(100) Amine-Cured Epoxy

3.13 COATING SYSTEM SCHEDULES, NONFERROUS METAL, PLASTIC, FIBERGLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames, or hatches. Use primers recommended by coating manufacturer.

SCHEDULE NO. AND APPLICATIONS	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
NFM-1: Exposed surfaces, indoors and outdoors, except those listed below.	Solvent cleaned SSPC-SP1	(1) Aliphatic Polyurethane
NFM-2: Chlorination room, chlorine storage room, sodium hypochlorite storage room.	Solvent cleaned SSPC-SP1	(100) Amine-Cured Epoxy
NFM-3: Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC-SP1	(8) Aluminum Metal Isolation

NFM-4: Polyvinyl chloride plastic, indoors and outdoors, not submerged.	Solvent cleaned SSPC-SP1	(4) Acrylic
NFM-5: Fiberglass surfaces.	Per paragraph 3.09, Plastic, Fiberglass, and Non-Ferrous Metals Surface Preparation	(6) Aliphatic Polyurethane Fiberglass

END OF SECTION

Section 11311

SUBMERSIBLE WASTEWATER PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submersible sewage pumps complete and operational with motors, control equipment and accessories as shown and specified.

B. Coordination:

1. Review installation procedures under other Sections and coordinate with the Work related to this Section.

2. Coordinate pumps and motors with electrical work as specified in Division 16, Electrical.

1.02 REFERENCES

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. American National Standards Institute (ANSI)

2. American Society for Testing and Materials (ASTM)

3. Anti-Friction Bearing Manufacturers Association (AFBMA)

4. Hydraulic Institute.

5. Institute of Electrical and Electronic Engineers (IEEE)

6. National Electric Code (NEC)

7. National Electrical Manufacturers Association (NEMA)

8. Steel Structures Painting Council (SSPC)

1.03 PERFORMANCE REQUIREMENTS

A. Furnish and install the submersible, non-clog wastewater pumps capable of handling raw unscreened sewage in accordance with these Specifications and as shown on the Drawings.

B. Number of pumps, minimum and maximum operating capacities, TDH, and other pump design data is tabulated on the Drawings.

Number of Units	1
Total Rated Dynamic Head, Feet	30
Capacity at Rated Head, GPM	50

C. Pumps shall be designed for continuous operation without cavitation within the specified operating range. The pump shall have a minimum hydraulic efficiency of 70 percent at the rated capacity.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330 - Submittal Procedures.

B. Submit a list of not less than 5 installations where pumping equipment of the type and approximate size specified has been in successful operation for at least 5 years.

C. Submit locations of the nearest permanent service headquarters of the pump and motor manufacturer for the size of pump and motor submitted.

D. Submit descriptive literature, including a cross-sectional view of each pump and motor combination, which indicates materials of construction, weights, principal dimensions and other important details.

E. Submit certified characteristic curves showing the head-capacity relationship, brake horsepower, NPSH requirements, pump efficiency (ratio of the water horsepower to brake horsepower) and pump speed. The curves shall be complete for the entire range of operation from shutoff to minimum head conditions. Submit manufacturer's calculation of radial and thrust bearing L-10 life at the head and flow indicated on the Drawings.

F. If the proposed pumping equipment is supplied with electrical equipment and components of larger capacity than specified or shown on the Contract Documents, the shop drawings for the equipment listed in the following Sections shall be submitted in the same package as the shop drawings submitted for this Section.

1. Section 16111 - Conduit, for conduit related to the submersible wastewater pump only.

G. Manufacturer's Certifications:

1. Submit manufacturer's certification that he has carefully examined the Contract Documents in detail, including the arrangement and conditions of proposed electrical, mechanical and structural systems affecting the performance of the pumping equipment units, and the detailed requirements of manufacturing and subsequent installation of the pumping equipment units.

2. Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that affects the pumping unit, as shown on the Drawings, which have not already been clarified in writing.

3. Submit manufacturer's certification that the running amperes of the motor will not exceed the nameplate rating of the motor under all expected operating conditions.

4. Submit manufacturers certification that spare parts, seals, bearings, o-rings and power cable shall be available locally for models to be supplied.

5. Submit manufacturer's certification that motors are explosion proof and labeled so, approved by Underwriters Laboratories (UL) or Factory Mutual (FM).

H. Record Drawings: Submit record drawing under provisions of Section 01785 - Project Record Documents.

I. Factory Tests: Submit 3 copies of certified test reports to the City Engineer for review.

1. The pump manufacturer shall perform the following inspections and tests on each pump before shipment:

   a. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.

   b. A motor and cable insulation test for moisture content or insulation defects shall be made.

   c. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

   d. Each pump shall be run submerged in water.

   e. After running pump submerged in water, retest motor and cable insulation.

2. If tests do not meet performance specifications, Contractor shall correct deficiencies to provide the specified performance.

3. A written report stating the foregoing steps have been done must be supplied with each pump at the time of shipment. This report must be approved by the City Engineer prior to payment.

J. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01782 - Operations and Maintenance Data.

1.05 QUALITY ASSURANCE

A. All materials used shall be new, of high grade, and with properties best suited to the work required.

B. Manufacturer's Qualifications:

1. Pumping equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Manufacturer shall satisfy the City Engineer that it is capable of the following:

   a. Providing local (within 50 miles of the limits of the City of Houston) factory trained personnel to service the pumps and allied equipment when needed within a 48 hour period.

   b. Providing all needed spare parts for the pumps within a 48-hour period.

3. Provide a written manufacturer's certification that spare parts, seals, bearings, o-rings and power cable shall be available locally for models to be supplied.

C. Coordination Responsibility

1. In order to ensure equipment compatibility, one manufacturer shall be responsible for providing all submersible wastewater pumping equipment, including pump and motor, access frame and guides.

2. The Contractor shall name a pump manufacturer, who will have responsibility for the function of the complete system in accordance with the intent of these Specifications. The named manufacturer shall be experienced in similar work.
3. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

D. Substitution. The engineering design is based on a certain manufacturer's equipment. If the Contractor's choice of equipment is approved but requires modifications to plant, equipment or piping for installation, the Contractor is responsible for submitting revised engineering design and drawings to make the proposed equipment compatible with the project, at no additional cost to the City.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment to site, all store and protect equipment under provisions of Section 01610 - Basic Product Requirement.

B. Store all equipment off the ground in enclosed shelter.

C. The pump cable end shall be sealed with a high quality protective covering to make it impervious to moisture or water seepage from submersion or other causes prior to electrical installation.

1.07 EVALUATION AND SELECTION

A. The City reserves the right to select any equipment which is deemed to be in its best interest.

1.08 WARRANTY

A. Provide warranty under provisions of Section 01770 - Closeout Procedures.

B. Pump manufacturer shall furnish to the City a warranty written expressly from the manufacturer to the City of Houston, covering workmanship and material for 5 years or 10,000 hours of operation under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of initial operation for City's beneficial use. Warranty shall be in printed form and previously published as the manufacturer's Standard Warranty for all similar units manufactured. Pumps repaired under warranty will be returned to the job site freight pre-paid.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. For approved manufacturers see Appendix for City of Seabrook Approved Products List

B. Through shop drawing submittals, the following named manufacturers will be considered, provided the submitted equipment meets the specified requirements and system operating conditions:

1. Flygt Pumps, Inc.

C. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to Contract Specifications.

2.02 PUMP CONSTRUCTION

A. Casing

1. Major pump components shall be of fine grained gray cast iron, ASTM A48, Class 30 or better, with smooth surfaces devoid of blow holes and other irregularities. Surfaces coming into contact with sewage, other than stainless steel shall be protected by an approved sewage resistant coating.

2. Mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber o-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical o-rings, grease or other devices shall be used.

3. Pump suction flange shall be drilled to ANSI standard, class 125.

B. Power Cable

1. The cable entry water seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall be sealed by an elastomer grommet, epoxy potting material, or a combination of both. The cable entry sealing system shall provide strain relief for the terminal connections and allow access to the terminal connections without adversely affecting the integrity or function of the seal system.

2. Cables shall be oil, grease and abrasion resistant, and meet applicable standards. The outer jacket shall be polyurethane or other material equally suitable for immersion in wastewater.

3. Cables shall be capable of operating on either 230 volt or 460 volt, 3 phase service and under continuous submergence without loss of watertight integrity to a depth of 65 feet.

4. No parallel power cables are acceptable unless they are size #1/0 or larger.

5. Motors 7.5 HP and over shall have reconnectable terminal blocks. All leads shall be numbered.

C. Submersible Motor

1. The pump motor shall be a NEMA Design B squirrel-cage, induction, shell type design, housed in an oil-filled or air-filled watertight chamber. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155 degrees C (311 degrees F). The use of bolts, pins or other fastening devices requiring penetration of the stator housing shall be rejected. The rotor bars and short circuit rings shall be of aluminum. The motor shall be designed for continuous duty, capable of sustaining a minimum of 15 starts per hour, evenly spaced. The pump/motor shall be capable of operating at liquid temperature of 104 degrees F per FM

requirements-without overheating or operating in the service factor. Motor shall be non-overloading over the entire range of the operating curve within the nameplate HP. A performance chart shall be provided showing curves for torque, current, a minimum service factor of 1.15, input/output kw and efficiency.

2. The motor shall be UL listed or FM approved as explosion-proof, suitable for NEC Class I, Division 1, Group C and D environments.

3. Each unit shall be provided with an adequately designed cooling system totally self-contained with no external mechanical devices. Pumps shall be designed to operate continuously with the fluid level at the top of the pump volute.

4. Maximum motor speed shall be 1200 rpm for pumps with discharge diameter greater than or equal to 6-inches.

5. For sizes 20 HP and smaller, the motor shall be equipped with dual voltage connections for 230/460 volts.

6. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with 3 thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with and supplemental to external motor overload protection and wired to the control panel.

7. For motor sizes larger than 100 HP, an independent thermal switch shall be included to monitor the lower motor bearing temperature.

8. The pump shall be equipped with moisture sensors in the oil-filled seal chamber to indicate seal leakage. Motors larger than 20 HP shall be equipped with a leakage sensor to detect water in the stator chamber.

D. Shaft: Each pump shaft shall be one piece of AISI type 420 stainless steel, or heat-treated carbon steel C 1035 protected by a stainless steel shaft sleeve. The shaft shall be of sufficient diameter to assure rigid support of the impeller and to prevent excessive vibration at all speeds.

E. Pump Seal: Each pump shall be provided with a tandem mechanical shaft seal system. The upper seal of the tandem set of seals shall operate in an oil chamber located just below the stator housing. This set shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon (or better) ring, and functions as an independent secondary barrier between the pumped liquid and the stator housing. The lower seal of the tandem set of seals functions as the primary barrier between the pumped liquid and the oil housing. This set shall consist of a stationary ring and a positively driven rotating ring both of which shall be silicon carbide or tungsten carbide. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring action between upper and lower seal faces shall not be acceptable.

F. Bearings: Bearings shall be permanently lubricated ball or roller type rated in accordance with AFBMA for an L-10 duty life of at least 80,000 hours at the rated capacity.

G. Impeller:

1. The impeller shall be of fine grained gray cast iron, Class 30 or better, dynamically or statically balanced, double shrouded non-clogging design having a long thrulet without acute turns. The impeller shall be capable of handling 3 inch minimum diameter solids, fibrous materials, heavy sludge and other matter found in normal sewage application. The impeller hub shall be accurately fitted and mechanically secured to the motor shaft.

2. The volute shall be of a single piece, concentric or non-concentric design, and shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller. The volute bottom shall be of a suction bell design for pumps with 12-inch discharge and larger.

3. A replaceable wear ring shall be installed to provide efficient sealing between the volute and impeller. The wear rings shall consist of AISI Series 300 or better heat-treated stainless steel. For pumps 10 HP and below the pump shall be equipped with brass or nitrite rubber volute wear ring only.

2.03 ACCESSORIES

A. Access Frames and Covers

1. Halliday Products Series H2R, U.S. Foundry Series AHD or AHS, or approved equal.

2. For watertight service, Halliday Products Series H2W, U.S. Foundry Series THD or THS, or approved equal.

3. Aluminum access frames and covers shall be provided by the pump supplier. Fasteners, hinges and other hardware shall be type 316 stainless steel.

4. The frame shall be extruded aluminum with an integral seat and anchor flange. Door leafs shall be 1/4-inch thick aluminum floor plate reinforced to H-20 live load with 30 percent impact factor per AASHTO specifications.

5. The access door shall be equipped with a flush cast aluminum drop handle which does not protrude above the cover surface and an automatic hold open arm with a red vinyl release grip, that automatically holds the door in a 90 degree open position utilizing a stainless steel pin at the point where the door meets the hold open arm.

6. Hinges shall be stainless steel with stainless steel tamperproof hardware. Doors shall be equipped with a stainless steel, watertight slamlock with a threaded aluminum plug, removable outside handle and an inside release handle. The slamlock must latch onto a stainless steel catch bolted to the frame.

7. Doors shall also include a recessed padlock assembly that consists of a cast aluminum enclosure that is sized to restrict access by bolt cutters, a stainless steel staple for a padlock and a hinged stainless steel cover which does not protrude above cover surface.

8. Doors shall be equipped with stainless steel spring operators for lift assist and to retard downward motion. All parts of the spring operator shall be stainless steel or aluminum and to ensure visual inspection. Spring operators shall be open type. The spring operators shall be engineered and installed so that in the event of slamlock failure the door will remain closed. The force required to open any one door leaf shall be a minimum of 5 pounds and a maximum of 20 pounds.

9. Apply bituminous paint on all areas that come in contact with concrete.

10. Exposed frame and door surfaces shall be painted dark green as approved by the City Engineer.

11. A written 10-year material and/or workmanship warranty on all components shall be provided.

B. Pump Guide System: Pump manufacturer shall provide a guide rail system complying with the following requirements:

1. Type 316 stainless steel rails, replaceable without man entry into the wetwell.

2. Lower bracket integral with pump support/discharge fitting.

3. Type 316 stainless steel upper bracket bolted to access cover frame.

4. Intermediate brackets as shown on the Drawings, if required.

C. Bolts, Studs and Nuts

1. All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, "Screw Threads", Coarse Thread Series, unless otherwise specified.

2. Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-Head Bolts and Nuts and Wrench Openings", Heavy Series, unless otherwise specified. All nuts shall be hexagonal in shape.

3. Anchor bolts, flange bolts, studs and nuts shall be Type 316 stainless steel in conformity with ASTM A276.

2.04 PUMP PROTECTION SYSTEM

A. Manufacturer shall furnish a complete pump monitoring and protection system consisting of an intrinsically safe solid state monitoring system to be installed in the motor starter cubicle, and independent probes integral to the pump/motor wired to a sealed cable entry terminal box for connection of submersible control cables.

B. Monitoring unit shall be solid state, intrinsically safe system designed for mounting within the motor starter cubicle. Monitoring system shall accept inputs from the sensors specified and shall output independent contacts which close to alarm each condition, or separate independent output terminals suitable for direct connection to interposing relays for alarm contact development. Provide a separate N.C. alarm contact, rated at 120V, 5A inductive, which opens on any failure. Monitor system shall be suitable for operation from a 24VAC unregulated, unlimited power supply. Provide any additional equipment or appurtenances required to provide current and voltage limited intrinsically safe installation as specified. The monitoring system shall accept separate isolated N.O. contacts which close to indicate pump running and to reset after pump trip.

C. Sensors shall be independently wired to the monitoring system. Provisions for the following sensors for each pump:

1. Stator leak (one required).

2. Stator temperature for pumps over 100 HP (one per phase, field test and connect to highest reading obtained).

3. Bearing temperature (one required).

2.05 SHOP PAINTING

A. Pump motor size up to 100 HP.

1. Pump Exterior:

a. Pre-treatment.

b. Primer. One coat of alkyd resin primer, 1.6 mils minimum.

c. Finish. Chloric rubber paint, 2.4 mils minimum.

2. Machine Finished Surfaces:

a. Machined parts are cleaned to remove all dirt and grease.

b. Cleaning is done so as not to affect primer or deteriorate adherence to finish paint.

c. Storage and transport is carried out in such a way that rust attack on machined surfaces does not occur.

d. At assembly, surfaces are coated with a corrosion preventive paint.

B. Pump motor size greater than 100 HP.

1. Pump Exterior:

a. Pre-treatment. Sandblast cleaning and removal of all oil and dust.

b. Primer. One coat of alkyd resin primer, 1.6 mils minimum.

c. Finish coat. Two coats of chloric rubber paint, 2.1 mils each coat.

2. Machine finished surfaces:

a. Machined parts are cleaned to remove all dirt and grease.

b. Cleaning is done so as not to affect primer or deteriorate adherence to finish paint.

c. Storage and transport is carried out in such a way that rust-attack on machined surfaces does not occur.

d. At assembly, surfaces are coated with a corrosion preventive paint.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of the pumping equipment shall conform to the manufacturer's instructions and recommendations and reviewed shop drawings.

B. Field Tests:

1. Each pump will be subjected to a 6-hour field operational test before acceptance as follows:

a. The unit under test shall be properly installed in the wet well, firmly upon its discharge connection after determination of (a) proper service voltage is being supplied and (b) proper rotation of the impeller. No cooling by forced or circulated air shall be allowed.

b. Capacity Test: On four occasions, wet well shall be filled with liquid to an elevation sufficient to allow each single pump to operate for 3 minutes, independent of the control regime. Time required to pump

down known volume shall be measured as evidence of each pump's capacity. All portions of the force main must have been constructed and tested prior to this test.

c. Snore Tests: Snore is defined as that state when the pump is alternately pumping liquid and air and usually occurs when the pump pumps the liquid down to expose its inlet. The unit(s) under test shall be submerged with just enough liquid to accomplish "snore" and allowed to run two times for 10 minutes minimum.

C. Start-up Data: Contractor shall complete and submit the start-up records and maintenance data sheets.

END OF SECTION

SECTION 11351

SECONDARY CLARIFIER MECHANISMS

PART 1 - GENERAL

1.1 SUMMARY

A. The contractor shall furnish and erect one (1) center feed/peripheral overflow type clarifier suitable for installation in an existing concrete tank of approx. 65' diameter x approx. 9'-3" side water depth with approx. 1'-6" free board, and a bottom slope of 1:12. Contractor to field verify dimensions. The mechanism shall be a center-column supported, center feed, peripheral overflow type with a center drive mechanism rotating a suspended cage with two (2) sludge scraper arms attached. The contractor shall verify all tank dimensions.

B. The equipment furnished for clarifier mechanism shall include but not be limited to: center assembly with drive unit, center column, influent feed well, center cage, scraper arms, RAS Booster Ring, access bridge with operating platform, scum collection system, algae brush cleaners (ABCs) and anchor bolts. The existing effluent trough, weir & scum baffle shall be replaced.

C. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacture's service.

D. Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall have a minimum thickness of 1/4". Stainless steel anchor bolts, with necessary hex nuts, washers and gaskets, shall be provided for all parts of the clarifier mechanism to be secured to the tank. All fasteners for high strength connections shall be ASTM A 325 high strength bolts and Grade 5 bolts for secondary connections. All handrail bolts and squeegee bolts will be 304 stainless steel.

E. Scum system including (but not limited to): The epoxy coated carbon steel pit (dimensions as noted in drawings), removable screen system, submersible pump, electrical control panel, local panel (HOA switch, and level control), valves and appurtenances, 2" SCH 80 PVC discharge scum Line (buried and exposed as shown on drawings) including, acrylic-based latex paint to all exposed pipe and pipefittings and pipe supports as necessary for a working system.

1.2 REFERENCES

A.	ASTM A36	Structural Steel Specification
B.	ASTM A325	Fastener Specification
C.	ASTM A304	Bolt Specification
D.	ASTM 316	Bolt Specification
E.	ASTM A48	Cast Iron Specification
F.	ASTM A536	Cast Iron Specification
G.	ANSI 4142	Heat Treated Steel Specification
H.	AGMA 6034-B92	Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

I.	AGMA 2001-D04	Fundamental Rating Factors and Calculation Methods for Involute Spur and helical Gear Teeth
J.	AWS	American Welding Society Current Standards
K.	AISC	American Institute of Steel Construction
L.	AISI	American Iron and Steel Institute
M.	SSPC	Steel Structures Painting Council

1.3 QUALITY ASSURANCE

A. The clarifier mechanisms shall be manufactured by Envirodyne Systems Inc. or pre-approved equal. The clarifier equipment manufacturer shall modify its standard equipment to meet the minimum values specified for dimensions, design, and the intent of this specification. ISO 9001:2008 certification is required.

B. Manufacturers regularly engaged in the manufacture of the clarifier equipment as specified herein and who can demonstrate equipment of this specified design, in actual service for a period of not less than 10 years will be considered as acceptable manufacturers. The Contractor shall provide a list of twenty (20) similar installations to be verified by the Engineer. The equipment must be operational for a minimum of five years. Manufacturers shall show evidence of quality assurance in manufacturing and supplying equipment essential in details to the equipment herein specified.

C. Manufacturers not named in the specification and meeting the requirements as set forth above must submit to the Engineer, 20 working days prior to the bid date, a complete pre-qualification package including a line-by-line comparison of the proposed equipment to these specifications. The pre-qualification package shall include a list of twenty (20) US installations of similar type equipment comparable to the units specified that have been in satisfactory use for a period of not less than ten (10) years. The installation list shall include, but not be limited to the following:

1. Name and location of installation
2. Name of person in direct responsible charge for the equipment
3. Address and phone number of person in direct responsible charge
4. Month and year the equipment was placed in operation
5. Brief description of equipment

1.4 CONTRACTOR SUBMITTAL

A. The manufacturer shall modify their standard equipment to meet the minimum values specified for dimension, design and intent of this specification.

B. Information required for approval by the Engineer prior to incorporation into the project shall include the following as a minimum requirement:

1. Certified dimension prints detailing all required anchor bolt locations.
2. Submit drive calculations certified by a Texas registered professional engineer and member of AGMA which shall substantiate the output torque rating of the drive, the reduction gearing ratios and torques, and the motor capacity. The PE shall be a bona fide full-time employee of the clarifier

manufacturer. The calculations shall clearly specify the values used for each of the following:

a. Worm and Worm Gear Diameters
b. Number of Pinions
c. Actual Face Width
d. Tooth Geometry Factor (I and J factors)
e. Load Distribution Factor
f. Allowable Contact Stress
g. Allowable Bending Stress
h. Pinion Pitch Diameter
i. Tooth Diameter Pitch
j. Hardness Ratio Factor
k. Elastic Coefficient
l. Stress Cycle Factor

The load distribution factor calculated from AGMA 2001-C95 for Cm and Km shall in no case be less than 1.20 and must be substantiated. The net face width for surface durability calculation shall not exceed the actual face width of the narrowest of the two mating gears. For parameters that are material dependent, such as allowable contact stress, the calculations shall include a full description of the materials and heat treatment used.

3. Specifications for all electrical and mechanical components and complete wiring diagrams for overload drive control.

4. Manufacturer's recommended procedures for jobsite storage and handling of equipment.

D. Operation and Maintenance Manuals: Prior to delivery of equipment and updated as required during installation of the equipment, the manufacturer shall furnish complete and detailed installation, operation and maintenance manuals which shall include the following information as a minimum requirement:

1. Assembly, erection, installation and adjustment instructions & drawings.
2. Operating, lubrication and maintenance instructions.
3. Complete descriptive literature of all materials and components furnished.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All submerged structural steel members shall be ASTM A36 steel and shall have a minimum thickness of ¼" unless noted and shall be capable of withstanding the momentary peak load without failure or plastic deflection. The clarifier(s) shall be so designed that there will be no chains, sprockets, bearings or operating mechanism below the liquid surface or in contact with the liquid.

2.2 EQUIPMENT

A. The center-column supported, center feed, peripheral overflow type clarifier mechanism(s) shall be model HBS with two (2) scraper arms attached to the drive cage. The clarifier shall be designed to scrape the entire tank bottom twice per revolution.

2.3 DRIVE ASSEMBLY

A. The Drive Mechanism shall be the Hercules™ Drive type and shall consist of an electric drive motor with a torque overload system, primary worm gear reducer, chain & sprockets with a 16 ga. fabricated stainless steel guard, shear pin coupling, intermediate worm gear reducer and pinion gear with enclosed spur gear in a heavy duty weldment housing.

B. Gear Design and Rating Criteria:

1. The drive assembly shall be rated to operate at the minimum Continuous Torque of 15,000 ft. lbs. This torque is the maximum torque required for normal operation of the mechanism on a 24 hr./day continuous 20-year service basis with an operating speed of approx 0.05 rpm.
2. The Alarm Torque is the maximum torque that the mechanism can achieve before activating an overload alarm. This torque is set at approx. 100% of the drive Continuous Torque.
3. The Motor Cut-Out Torque is the maximum running torque for which the machine is designed. Self-correction of a torque overload condition shall be possible until the Motor Cut-Out Torque is reached. The motor HP shall be based on this torque. The Motor Cut-Out Torque is set at approx. 120% of the drive Continuous Torque, a value equivalent to 18,000 ft. lbs.
4. Maximum Operating Torque is the rating based on the safe dynamic continuous loading of the gear teeth to withstand the repeated impact loads of the specified service. The surface endurance of the gear materials and life of the bearings shall be adequate to withstand short periods of the dynamic load capacity of the gears.
5. Momentary Peak Torque is the dynamic load capacity of the drive assembly developed momentarily as starting torque or a sudden buildup of torque. This Momentary Peak Torque is set at 30,000 ft. lbs.
6. All gears shall be designed for surface durability, strength & geometry in accordance with the latest applicable standards of the AGMA, ANSI and British Standard of spur, worm and helical gearing. All bearings shall be selected in accordance with applicable AFBMA-ANSI standards.
7. All pinions, spur gears and helical gearing shall conform to AGMA 2001-D04, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
8. The output torque rating of the drive shall be based on the smaller of the values determined from the above AGMA standards.

C. Drive Motor, Primary and Intermediate Helical Gear Reducers

1. The drive motor shall be a constant speed, TEFC, "C" face mount, NEMA Design B "squirrel cage" for 230/460 volt, 3 phase, 60 Hz. current, chemical "dirty duty" service with 1.15 S.F., Class F insulation with a Class B temperature rise. The motor shall be rated for minimum 2 HP and shall be

adequate to start and continuously operate the mechanism at the maximum load encountered under any operating condition without overloading or exceeding the nameplate rating. The drive motor shall be C-face coupled, direct connected to the primary speed reducer. The use of chains, V-belts or exposed shaft couplings between the motor and primary speed reducer will not be accepted.

2. The primary and secondary speed reducers shall be helical type, in an ASTM A48 cast iron housing with oil immersed gearing. Non-AGMA rated reducers (e.g. cycloidal drives) are not acceptable. The speed reducer is to have anti-friction tapered roller bearings on both sides to prevent tipping of the gear. The housing is to be located via a machined, registered fit (min 3/8" deep) to insure proper alignment is maintained under operating load conditions. Pockets or cavities below the platform are not acceptable due to the inability to remove collected water and debris.

D. Main Gear, Pinion and Housing

1. The final gear reduction shall be an oil-bath lubricated solid one-piece internal spur gear/anti-friction four-point contact precision design ball bearing assembly mounted in a steel weldment housing. The main gear housing shall be bolted to the top of the stationary center column and shall be capable of transmitting the mechanical design strength.
2. The gear housing shall be a heavy duty ASTM A36 steel weldment sealed housing designed to support the drive cage, arms, influent feedwell, one end of access bridge and other applied loads. Cast iron housings will not be acceptable due their potential to develop cracks, pinholes and leaks. The housing shall be constructed using proper wall thickness designed to resist deflection at full momentary peak torque. The oil dam in the main gear housing shall be full sidewall construction integral with the turntable base. A condensation collection sump shall be provided.
3. The main spur gear shall be forged of alloy hardened steel and conform to AGMA 6 or better and have a minimum Brinell hardness of 300. The gear shall have a minimum pitch diameter of 32" and shall be supported by and rotated upon the main bearing. The spur gear face surface area shall have a minimum of 351 sq. inches to insure minimal contact stress and mechanical stability and shall match the face and teeth of the pinion gear. The face surface area is defined as the spur gear pitch diameter times the spur gear face width times 3.14.
4. The bearing raceway shall be precision ground and deep induction hardened to Rockwell C60 for maximum capacity and to provide true rolling action without the need for strip liners. Drives that require strip liners are not acceptable due to the fact that strip liner wear causes non-uniform rolling action of the balls which could cause the mechanism to "rock" out of plumb. The balls shall be matched precision chrome-alloy steel with hemispherically faced spacers designed to provide uniform load distribution. The balls and spur gear shall run in an oil bath with minimum 85% gear submergence. The bearing rings shall be minimum 123,000 PSI tensile forged steel with a tooth hardness of minimum R_C56. Bearing life shall be a minimum of 100 years per AFBMA L-10.

5. The main bearing shall have a minimum ball race diameter of 37" and shall be capable of withstanding an overturning moment without the aid of any underwater guides or bearings to insure correct tooth contact for AGMA rating of the main gear.
6. A "Pop-Top™" feature shall be provided such that the spur gear/turntable assembly is easily removable without removing the access bridge and rotating mechanism or draining the tank. All work shall be performed with the aid of only portable hoists. Shop drawings shall include a demonstration video.
7. The pinion gear shall be heat treated AISI 4340 alloy steel. The pinion gear shall be keyed to the output shaft of the intermediate speed reducer and supported by bearings on both sides which are fitted into machined pilots.
8. The drive base shall be thoroughly inspected for seep holes or inclusions and given a full hydrostatic test to insure of no leaks in the oil containment area. The complete drive shall be assembled in the manufacturer's shop and tested to assure that the drive is running properly and to calibrate the drive control. A complete test report shall be sent to the engineer verifying that the drive meets the quality assurance of the manufacturer and engineer.

E. Torque Control Device
1. The drive assembly shall be equipped with an electro-mechanical torque control device. The pointer shall be covered by a plexiglass window providing a visual reading of the relative main gear output torque on a 0 to 100 percent graduated scale. The overload device shall sense two (2) torques – one to energize an alarm when the loading reaches the specified Alarm Torque, the other to actuate the motor cut-off switch when the loading reaches the specified Motor Cut-Out Torque.
2. The overload device, control switches, and electrical terminals shall be mounted in a waetherproof enclosure.

F. Walkway and Drive Platform:
1. The clarifier shall be provided with a 36" wide walkway with handrails. The walkway shall be supported at the center by the drive unit and supported on the opposite end by the tank wall. The walkway shall be designed to safely withstand all dead loads plus a live load of 50 pounds per square foot with a maximum deflection of l/360, over the entire span. The walkway shall consist of two (2) beams diagonally and cross-braced to resist the specified loads. The walkway surface shall be 1-1/4" aluminum grating.
2. A center drive platform shall be provided. It shall be a minimum of 8'-0" square to provide clearance around the center assembly and drive for maintenance and service. It shall consist of 3/16" thick aluminum checkered floor plate with necessary stiffeners and supports, resting on the center assembly and provided with connections to the walkway.
3. Handrails shall be 42" high of 1-1/2" diameter Schedule 40 double-row horizontal aluminum pipe shall surround the center drive operating platform. A 4" x ¼" thick minimum toe board shall be provided around the drive platform.
4. Steel bearing plates, UHMW polyethylene slide plates and anchor bolts for the wall supports shall be supplied by the manufacturer.

G. Center Column:

1. A minimum 24" diameter x min. 1/4" wall stationary center column shall be provided. One end shall have a 1-1/4" thick support flange for bolting to the existing concrete center pier, with a minimum of (6) 1-1/4" diameter epoxy-type 304 stainless steel anchor bolts. A similar flange shall be provided at the top of the column for securing the center drive assembly.
2. Influent openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the energy dissipating inlet. Influent velocity shall be reduced by providing a total inlet port area a minimum of 135 percent of the center column cross sectional area.
3. A concentric adapter shall be provided to mate with the existing RAS line and new RAS booster ring.
4. Prior to the center column being grouted in place, the drive unit shall be installed, positioned and leveled.

H. Center Cage and Rake Arms:

1. The center cage shall be of steel box truss construction. It shall be provided with the connections for the scraper arms. The cage top shall be bolted to the main gear, which shall rotate the cage with the attached arms. The minimum angle size used for the cage and rake arms shall be 2" x 2" x 1/4".
2. The clarifier mechanism shall include two (2) sludge removal arms of steel rectangular truss construction. Attached to the arms shall be steel spiral scraper blades designed to sweep the tank floor twice per revolution. Adjustable 20 gauge 304 stainless steel squeegees shall be attached to the rake blades with Type 304 stainless steel fasteners. The rake blades shall be designed to direct sludge to the RAS Booster Ring at the center of the tank.
3. The cage and rake arms shall be designed such that calculated stresses do not exceed the AISC allowable stress at the momentary peak torque rating.

I. Influent Feedwell:

1. The feedwell shall be fabricated out of 3/16" steel plate.
2. Sufficient reinforcing rim angles shall be provided as required. The well shall be supported by the drive cage and rotate with the clarifier mechanism.
3. The rotating influent feedwell shall be min. 15'-0" dia. with a side depth of min. 5'-0". Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
4. The influent feedwell shall be supported by structural ASTM A36 members either extending out from the cage or up from the rake arms.
5. The influent feedwell shall be made of not less than 3/16" thick steel plate with necessary stiffening angles. .

J. RAS Booster Ring:

1. The RAS booster system shall be a ring designed to continuously remove sludge from the face of each blade at the point of highest concentration. This ensures uniform return sludge concentration and eliminates rat holing. The ring shall have a rectangular cross section with two (2) orifice headers oriented at 180 degrees, each immediately in front of the respective spiral blade. To eliminate the possibility of diluting the settled activated sludge, the orifices shall rotate with the blade and no orifice shall ever be behind a blade.
2. The unit shall consist of a stationary ring attached to the center column, a stationary outer housing anchored to the tank bottom and a rotating ring with inner and outer seal assemblies. Cover plates shall be provided over the

existing sludge hoppers. All components shall be constructed of minimum ¼" steel plate, suitably reinforced as required to operate under a static head of 20 feet. The ring shall also be self-cleaning. Designs lacking this important maintenance feature are not acceptable.

3. The rotating ring shall be attached to the drive cage in a manner that will permit field adjustment of the horizontal and vertical alignment to insure proper seal seating and to compensate for the applied hydraulic load conditions after the tank is filled. Each seal assembly shall consist of two (2) ¼" thick fabric-reinforced neoprene seals riding on a stationary UHMW polyethylene plate and shall include a steel backup plate.
4. The seal assemblies shall be located at least 8" off the tank bottom to minimize seal wear due to abrasive material in the sludge. All seals are to be oriented horizontally and riding flat. Seals riding vertically or partially vertical shall not be acceptable. The seal assemblies shall be designed so that replacement can be made without disassembling the unit.
5. Each seal assembly shall consist of two (2) ¼" thick fabric-reinforced neoprene seals riding on a stationary UHMW polyethylene plate and shall include a steel backup plate.
6. The sludge removal headers shall be attached to the ring so that all static, hydraulic and buoyant forces are transmitted from the headers to the drive cage and not to the ring.
7. The sludge shall flow by direct suction from each sludge removal header into the sludge withdrawal ring and then into the bottom sludge draw-off line.

K. Scum Removal Equipment:

1. Surface scum skimming equipment shall be furnished with each clarifier mechanism. Two (2) scum skimmers shall be provided to sweep the surface scum twice per revolution.
2. Each skimmer shall consist of a rotating steel deflector blade supported from the scraper arm below and extending tangentially from the influent well to the scum trough with a hinged end blade for the width of the trough.
3. The hinged blade shall be aluminum construction and shall have neoprene squeegees to properly seal entrapped scum and water and to convey the collected scum up an inclined shelf plate into the scum trough.
4. The scum trough shall be 4'-0" wide x 6'-0" long, minimum 1/4" thick steel with a 6" plain end connection for the scum discharge pipe. Adequate bracing shall be provided to support the scum trough from the tank wall.
5. The scum trough shall be equipped with a flush valve assembly for automatic flushing of the scum box and scum pipe. The flush valve assembly shall allow approximately 2 to 5 gallons of clarified effluent to enter the box as the skimmer assembly passes over the scum box. It shall consist of an adjustable trip lever and hinged seat with seal that will lift to open the valve. A counterweight shall return the valve to its closed position after the flush cycle.
6. A min. 1/4" thick fabricated steel scum pit with submersible scum pump shall be provided for installation by the Contractor on the exterior of the clarifier tank. Local panel to be Nema 4X and include emergency shut down (Red mushroom) button and an H.O.A. switch outside the panel. Panel to be located within 10 ft of scum-pit. Electrical controls and float switches for automatic operation of the scum pump shall be coordinated and provided by

the Contractor.

L. Algae Brush Cleaning (ABC) Equipment:

1. The algae cleaning system shall be static brush-type custom designed to clean the following surfaces once per revolution:
   a. outside of weir
   b. inside of weir
   c. inner effluent launder wall
   d. effluent launder bottom
   e. outer effluent launder wall
   f. outside of scum baffle
   g. inside of scum baffle
2. All system components shall be type 304 stainless steel or better.
3. Brushes shall be constructed with durable polypropylene or nylon bristles.
4. Brush arms shall be spring-loaded so that the brushes conform to the surfaces being cleaned.
5. A shear safety component shall be provided for each brush to actuate at less than 100 lbs. force. Each brush shall be field tested in the presence of the Engineer/Owner to demonstrate proper breakaway performance. Breakable pins shall not be used.
6. The ABCs shall be manufactured by the clarifier equipment manufacturer to ensure product quality and compatibility. Units purchased from third party vendors are not acceptable.

M Clarifier Weirs

1. The effluent weirs shall consist of 1/4" plate 2'-0" W x 2'-0" deep segregated design with 18 chords weir in both sides, scum baffle on inboard side only and include steel supports & drop plates & washers. (replace in kind). The weirs shall anchor to the ¼" plate launder trough wall with a minimum 1/2" diameter stainless steel bolts at 12" on center. Provide 1/4 inch neoprene gasket designed to seal weirs against leakage. Weirs shall be adjustable vertically at least one-half inch (1-1/2").
2. The effluent trough shall be constructed of ¼" plate.
3. The troughs shall be made of ¼" steel plate. Each trough shall be no less than 24" wide. The troughs shall be hot-dip galvanized after fabrication.
4. Provide a minimum 12" high scum baffle fabricated from 3/16" galvanized steel plate, extending to an adequate height above the static water level to prevent overflow. The scum baffle shall be supported at intervals not to exceed 4 foot on center.
5. Contractor to provide B.O.M, and submittal drawings of the portions to be replaced.

2.4 PAINTING AND SURFACE PREPARATION

A. All steelwork (except drive) to be hot dip galvanized after fabrication in accordance with ASTM A123. Pieces shall be fabricated in maximum sizes suitable for shipping and galvanizing. Minor defects in the hot dip galvanizing coating caused by shipping, handling or installation shall be repaired after equipment installation. The defects shall be thoroughly cleaned and wire brushed to remove all foreign substances, wiped clean

with a damp rag, thoroughly dried and coated with at least two (2) 2-mil coats of a zinc rich compound conforming to U.S.N. Specification MIL-P-21035, or U.S.A.F. Specification MIL-P-26915A.

B. Gear motors and drive mechanism shall be furnished with manufacturer's standard enamel paint system.

2.5 SPARE PARTS

A. The intent of this specification is to provide non-interrupted continuous operation. The manufacturer shall supply as a minimum, the following spare parts:
   1. Six (6) shear pins.
   2. Two (2) neoprene skimmer wipers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The equipment shall be erected in strict accordance with manufacturer's recommendations. The concrete tank and stairs of the Secondary Clarifiers must be modified per the Contract Drawings to accommodate the Algae Cleaning System. The concrete launder spillway at the existing bridge location of the Primary Clarifiers must be chamfered to accommodate the Algae Cleaning System.

3.2 SERVICE

A. The equipment manufacturer shall provide a service man properly trained in inspection and operation of the mechanism to approve the installation, certify torque, run the test and instruct the owner personnel on maintenance and operation. This service shall be in the form of one (1) trip to the site and minimum two (2), eight (8) hour days of service. Any additional service shall be provided by the contractor at his expense for improper installation or delayed check-out of operator training.

3.3 TESTS

A. The purpose of the test shall be to verify the structural integrity of the mechanism and drive. The manufacturer shall provide a qualified service representative to supervise the testing.

B. The clarifier mechanism shall be field torque tested. The testing shall be carried out under the supervision of the equipment manufacturer's representative before the mechanism is approved and placed into operation.

C. The torque test shall consist of securing the arms by cables to anchor bolts installed by the contractor in the tank floor at locations recommended by the equipment manufacturer and the Engineer. A torque load shall be applied to the scraper arm by means of a ratchet lever and cylinder connected to the cable assembly.

D. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the centerline of the mechanism. Readings shall be taken at 100%, 120%, and 130% of design torque value. The test load shall be applied and noted on the torque overload device.

E. The manufacturer's service representative shall certify that the alarm and motor cut-out torque of the drives as calibrated in the manufacturer's shop are in proper operation to shut down the units as specified.

Section 15053

PUMP STATION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping for pump station wet well and valve vault, as shown on the Drawings.

1.02 REFERENCES

A. ANSI A21.10, AWWA C110 - Ductile Iron Fittings 3 in. through 48 in., for water and other liquid.

B. ANSI B36 - Stainless Steel Pipe.

C. AWWA C151 - Ductile Iron Pipe, centrifugally cast in metal molds or sand-lined molds for water or other liquids.

D. ANSI A21.15, AWWA C115 - Flanged Ductile Iron Pipe with Threaded Flanges.

E. ANSI B16.1 Ductile Iron Pipe Flanges and Flanged Fittings.

F. AWWA C111, ANSI A21.11 - Rubber Gasket Joints.

G. AWWA C600 - Hydrostatic Testing.

H. AWWA C606 - Grooved and Shouldered Joints.

I. ANSI B1.1 Screw Threads.

J. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

K. ASTM A194 - Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01300 – Submittal Procedures.

B. Submit detailed drawings on pipe, joints, gaskets, fittings, flange coupling adapters, and appurtenances.

C. Submit shop drawings indicating dimensions, layout of piping, elevations, intersections, connections, support system, etc.

D. Submit manufacturer's Certification of Compliance with ANSI, AWWA and other Standards listed herein.

E. Submit description of proposed testing methods, procedures and apparatus and test reports for each system.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Piping and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all piping and appurtenances of the same specific type shall be the product of one 1 manufacturer.

PART 2 P R O D U C T S

2.01 MATERIALS

A. For approved manufacturers see Appendix for City of Seabrook Approved Products List

B. Ductile Iron Pipe: AWWA C151, Class 53 minimum.

1. Fittings: AWWA C110

2. Joints: AWWA C115, with threaded flanges and rubber gaskets.

3. Bolts, studs and nuts: ASTM A-316 stainless steel.

4. Flanges: Same material as pipe and screwed onto the pipe in accordance with ANSI B16.1. Use screwed-on flanges attached to the pipe by the pipe manufacturer or pipe manufacturer's authorized fabricator.

5. After flange attachment, have flange and pipe re-faced so that the end of the pipe is even with the face of the flange and both are perpendicular to the axis of the pipe.

6. All flanged joints shall be hydrostatically tested after fabrication to a pressure rating of 300 psi minimum. All flanged joints shall be marked (Tested at 300 psi) and notarized certification papers supplied to the purchaser.

7. Align bolt holes on both flanges at the end of each piece of pipe.

8. Where cap screws or stud bolts are required, incorporate tapped holes for such cap screws or stud bolts in the flanges.

9. Interior Lining: Use one of the following interior lining systems.

   a. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D1248, heat fused to interior of pipe.

   b. Nominal 40 mils (35 mils minimum) polyurethane, such as Corro-pipe II by Madison Chemicals, or Polythane by U.S. Pipe.

   c. Approved equal.

10. Exterior Coating: Coat pipe in accordance with Section 09901 - Protective Coatings.

11. Performance: Use pipes and fittings designed for an internal working pressure range of -10 to +150 psi.

A. Wall Pipes: Ductile iron flanged with water stop collar.

1. Ductile iron water stop collar to be welded on the wall pipe prior to installation of the interior lining.

2. Interior Lining: As specified for pipe in paragraph 2.01A.9.

3. Bolts, studs and nuts: Type 316 stainless steel.

A. Flanged Coupling Adapter:

1. Type: Ductile iron; Romac Industries, Style FCA501, Dresser Style 128, or approved equal.

2. Interior Lining: As specified for pipe in paragraph 2.01A.9, or heat-fused epoxy coating complying with AWWA C213.

3. Bolts, studs and nuts: Type 316 stainless steel.

B. Grooved Couplings: Grooved couplings conforming to AWWA C606 may be used for exposed piping outside of the wet well.

1. Manufacturers: Gustin-Bacon, Victualic Style 31 (flexible or rigid).

2. Bolts and Nuts: Type 316 Stainless Steel.

3. Gaskets: Flush seal type, compatible with the fluid, according to the manufacturer's recommendations.

4. Pipe Wall Thickness: Wall thickness of grooved piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.

5. Equipment Connections: Equipment connections shall be rigid-type grooved couplings unless thrust restraint is provided by other means.

6. Require the manufacturer to verify correct choice and installation of couplings, gaskets, and workmanship to assure correct installation.

A. Air Release Piping: Schedule 40, ANSI B36 stainless steel with ANSI B1.20.1 threaded joints.

PART 3 EXECUTION

3.01 INSTALLATION

A. Check dimensions shown on the Drawings prior to installation of Work. Notify the Project Manager promptly of any conflicts or errors.

B. Run pipe lines straight and true in alignment, grade and location as shown on the Drawings.

C. Install piping through walls and floors as shown on the Drawings.

3.02 PIPE IDENTIFICATION LABELS

A. Label piping as follows:

1. Identify all piping with plastic sleeve snap-on markers equivalent to Seton Name Plate "Setmark" or approved equal with 3/4-inch letters on pipe sizes to 4-inch and 2-inch letters on pipe sizes 5-inches and larger, or approved equal.

2. Locate at each valve, each branch take-off, and at each side of floor or wall through which pipe passes.

3. Not more than one label is required every 12 feet if adjacent label is visible.

4. Place labels on all lines.

3.03 TESTING

A. Flush pipes clean. Tighten connections to stop any visible leaks.

B. Test piping in accordance with Section 4-Hydrostatic Testing, AWWA C600.

C. Test piping to a pressure of 150 percent of the maximum possible discharge pressure of the pumps.

3.04 PAINTING

A. Paint pipe in accordance with Section 09901 - Protective Coatings.

END OF SECTION

SECTION 15140

PIPE HANGERS, SUPPORTS AND RESTRAINTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pipe and equipment hangers, supports, and associated anchors

B. Equipment bases and supports

C. Sleeves and seals

1.02 REFERENCES

A. ANSI/ASME B31.1 - Power Piping, Sections 120 and 121 of ASME B31.1.

1.03 SUBMITTALS

A. A layout of the systems including location on fixed and movable joints.

B. Details of design and fabrication of joints.

C. Details of support brackets, cradles, pads, thrust resisting elements, and other supporting elements.

D. Other pertinent elements necessary for a complete installation.

E. Design calculations for all items.

PART 2 P R O D U C T S

2.01 HANGERS AND SUPPORTS

A. Hangers for uninsulated lines 2 inches and less and for all drainage and downspout lines shall be adjustable swivel ring type fabricated of malleable iron.

B. Hangers for uninsulated lines larger than 2 inches and of insulated lines, except drainage and downspout piping, shall be adjustable clevis type. Hangers shall be sized to allow insulation to extend unbroken through the hanger.

C. Hangers installed in valve vaults, wet wells, and other below grade areas shall be cadmium plated or stainless steel.

2.02 INSERTS

A. Inserts for individual hangers shall be galvanized malleable iron, and shall include removable nuts held in place by V-type teeth on the insert body and nut. Continuous slotted channel inserts shall be galvanized steel with integral anchors at 6-inch centers. Provide factory finished steel snap-on cover plates on channel inserts between support attachments.

2.03 EXPANSION BOLTS

A. Expansion bolts for support shall be stainless steel wedge type. Expansion bolt anchors with lead shall not be used.

2.04 PIPE SADDLES

A. Pipe saddles shall be fabricated hot dip galvanized steel. Saddles for supporting pipe from the floor shall be at least 9 inches in length and as wide as the outside diameter of the pipe. Saddles shall have a bearing support of 120 degrees. Mount saddles on concrete pads at least 2-inches high.

2.05 FRAMES HANGERS

A. Framing for wall type hangers, trapeze hangers, and tunnel stanchions shall be factory fabricated metal framing systems with factory applied primer paint. Attach supports to structures with inserts for new concrete, with surface mounting methods for masonry or existing concrete, and with welding or clamps for structural steel. Pipe supports fabricated on the site shall be of structural steel members with all raw edges ground and dressed. Floor supports in areas with uncovered concrete floors shall rest on concrete pads not less than 2 inches high.

PART 3 E X E C U T I O N

3.01 GENERAL

A. Piping inside structures shall be hung, supported from the floor or racked adjacent to walls.

B. Inserts cast in concrete walls or slabs for hanging and supporting pipe shall be provided under this Section. Materials not galvanized or cadmium plated shall be prime painted before installation.

C. Support components shall be designed fabricated, and installed in general conformance with Sections 120 and 121 of ANSI B31.1, Power Piping, except as modified in this Section.

3.02 PIPE HANGERS AND SUPPORTS

A. Interior piping shall be supported, braced, and anchored to prevent movement in any direction because of pressure, temperature, flow, or water hammer, except at properly located expansion joints and fittings.

B. Provide two pipe guides on each side of expansion joints at which pipe movement occurs. The first guide shall be not more than 4-pipe diameters from the joint and the second not more than 14 diameters. Provide additional guides as required to maintain pipe alignment, spaced as required for the pipe size, fluid pressure and temperature inside the pipe, and as recommended by the expansion joint manufacturer or as shown.

C. Maximum support spacing and hanger rod sizes for metal pipe containing liquids shall be in accordance with the following:

Nominal Pipe Size Inches	Support Spacing Feet	Rod Diameter in Inches One Rod	Two Rods
1 And Smaller	7	3/8	3/8
1-1/4 And 1-1/2	8	3/8	3/8
2	10	3/8	3/8
2-1/2	11	1/2	3/8
3	12	1/2	3/8
4 And 5	14	1/2	3/8
6 And 8	17	1/2	3/8
10	17	5/8	1/2
12	17	3/4	1/2
14	17	3/4	5/8
16	17	7/8	5/8
18 And 20	17	1	3/4
24	17	1-1/8	7/8

D. Valves 4 inches and larger in unburied horizontal lines shall have supports on both sides located within 18 inches of the valve or meter. Provide additional supports where required so that piping loads do not place damaging stresses on supports, valves, and equipment. Where necessary, block up pipe at supports to permit installation of insulation.

E. Support unburied horizontal runs of rubber hose and non-metallic pipe for the entire length by means of troughs consisting of structural steel channels or angles supported at not more than 10-ft intervals.

F. Support piping not included in the foregoing tabulation as indicated or in accordance with the pipe manufacturer's recommendations if not indicated.

G. Anchor buried pressure pipe at each fitting causing a change in direction of 10 degrees or more. Concrete thrust blocks or other restraining devices in any satisfactory combination may be used. Submit the details of the method proposed

for use, together with design calculations, to Engineer for approval before installation.

END OF SECTION

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STATE OF TEXAS
GARY W. WILLISON
63157
REGISTERED
PROFESSIONAL ENGINEER

05/12/2017

Coastal Bend Consultants, Inc.
TBPE Firm Reg. No. F-1069

1.0 GENERAL

1.1 DESCRIPTION

a. The work shall include providing materials and equipment required for installation of complete and functioning electrical system as specified and as shown on the drawings. Unless noted in the Bidsheet, no separate payment will be made for work under this section. Include payment in unit price for applicable work as noted on the Bidsheet.

b. This section is an integral part of all Specification Sections related to electrical, control and instrumentation construction under this contract. Conditions of this section are paramont to all other conditions in applicable sections and shall supercede all other conditions and requirements.

c. Electrical Control and Instrumentation Plans & Specifications are representative of the design intent and may not contain minute details normally associated with normally accepted electrical construction, as described in applicable codes or as described in manufacturer's literature. Contractor shall provide all appurtenances normally associated with a particular equipment or device, and as required for a properly operating system.

d. Electrical Contractor is responsible for ensuring that the latest edition of the NEC is complied with, including but not limited to, the cross referencing of cited NEC articles to current NEC articles.

1.2 MAJOR ITEMS OF WORK AS FOLLOWS – for the City of Seabrook Wastewater Treatment Plant – Clarifier Scum Pump Addition

a. Bus Tap MCC for power feeder to one (1) 20A/3P fused disconnect for the proposed Scum Pump Control Panel.
b. Install fused disconnect in the existing blower room.
c. Install motor feeder conduits and conductors to proposed Scum Pump..
d. Route alarm conduit and conductors from Scum Pump area to MCC Room.
e. Install Area lighting at the proposed Scum Pump area.
f. Caulk conduit penetrations in the exterior and interior walls of the MCC room.
g. Site Grounding System additions and/or modifications, as required by NEC.

1.3 PLANT CONTROL SYSTEM

a. The Contractor shall furnish and install a complete operating control system. The control system shall include but shall not be limited to all circuit breakers, motor starter, contactors, indicating lights, selector switches, lightning arrestor, surge capacitor, phase failure relays, elapsed time meters, alarm horn, push button, control transformer, ammeters, volt meters, interlock wiring, control piping, blocks, valves, nameplates, and all other associated items required to provide a workable system. All pump controls to have level and pressure call and reset devices, motor start time delays and, elapse time meters installed.

b. Provide circuit conductors, conduits, circuit breakers, and related devices for furnishing power to all motor heaters, instruments, devices, lights, controls, and other equipment provided by vendors, or others for this project.

c. Control diagrams shown on plans are illustrative in nature and may require additional devices such as time delays, resets and other devices required for a proposed control system. No RACE conditions shall exist in controls operation.

d. All controls shall be fully tested in shop for proper and satisfactory operation, prior to installation at site. Contractor to provide written certification before delivery to site. Any installations without certification notice are done at risk by Contractor, who shall be obligated to make all necessary corrections in field at no additional cost to owner.

1.4 SUBMITTALS

a. Submit all products covered under this section for Engineer's approval.

b. Where submittals for a particular equipment, device or material item vary from that specified or shown on plan drawings, and where that item is not specifically noted as acceptable and, where installation of submitted item results in improper or undesirable operation of the system, Contractor shall be liable for removal and/or replacement of that item with the item specified or shown on plan drawings at no additional cost to Owner.

1.5 CONTRACTORS RESPONSIBILITIES

a. Electrical Contractor shall coordinate electrical power, telephone, data or special purpose line installation with utility companies. Within 30 days after award of contract, Electrical contractor shall contact utility company and owner and shall request service needed.

It is Electrical Contractors sole responsibility to assure that utility company and Owner are notified and are kept aware of requirements.

b. Contractor shall provide all conduit, conductors and termination equipment as needed for utilities and shall coordinate with utility companies for installation requirements and shall provide installation constructed according to the utility company standards whether or not such is shown in detail or plans.

c. Electrical Contractor shall review all sections of the plans including Civil, Structural, Mechanical, Instrumentation, Process, Architectural, and Electrical and shall note all electrical requirements for devices and equipment shown or implied, and shall provide service accordingly for a complete operating electrical system.

d. Electrical Contractor shall provide all programming set-up, adjustments and testing of devices or equipment included under this contract unless specifically excluded or unless equipment is not provided by Electrical Contractor.

e. General Contractor is specifically responsible for coordination of all electrical systems, devices and equipment provided or installed under this contract and shall assure that all requirements by all trades are met such as to insure a complete and operating electrical, control, process or instrumentation system. Special attention shall be given to coordination of motors supplied and MCC components supplied. This includes verification of compatibility of all interfacing connectors and devices at new, existing, and Owner furnished equipment. Notify Engineer of any discrepancies before ordering equipment. Failure to do so may result in additional cost to Contractor.

f. Electrical Contractor shall be experienced with all types of electrical systems covered under this contract. No work shall be undertaken where Contractor's firm, project supervisors and project electrical workers have not had recent experience in similar projects in area of project location. Contractor will be required to furnish proof of experience where requested by Owner or Engineer or their Representatives.

g. General Contractors Project Manager or his Assistant shall be familiar with types of electrical construction required by this project in order to determine that all subcontractors work in conformance with the plans and specifications.

h. Contractor shall assure that all systems have been properly installed, adjusted and tested prior to final inspection, unless, Engineer has been duly notified in writing that certain equipments are not ready for final testing and such is acceptable with Engineer.

i. Contractor shall fully inspect all motors and nameplates, controls, conduit, wiring devices and other items before starting work, ordering materials or submitting shop drawings in order to verify existing conditions are as shown on plans and, shall immediately notify Engineer of any discrepancies between plans & specifications and existing conditions. Failure to do so may result in Contractor's responsibility for any required changes in construction. This includes verification of compatibility of all interfacing connectors and devices for new, existing, and Owner furnished

equipment. Notify Engineer of any discrepancies before ordering equipment. Failure to do so may result in additional cost to Contractor.

j. At completion of project and before final inspection, Contractor shall provide the Electrical Engineer with full size blue prints, red-lined to reflect the "As-Built" electrical installation. Any variation from plans shall be shown on each applicable plan sheet.

k. When work involves modifications or additions to existing plant, Contractor shall make provisions for continuous electrical service thru normal power or standby generator power. Where standby generator exists but, will be temporarily out of service during construction, Contractor shall provide substitute generator power for duration of outage.

In no event shall plant be without operating power or, without standby generator service where generator exists. Include all transfer switches, fuel tank, fuel, attendance and appurtenances required for a complete power system as needed for interim plant operation.

l. Where work involves additions, modification, demolition or renovations to existing facilities, Contractor shall remove, relocate and extend existing installations to accommodate new construction.

m. Provide electrical circuits to all equipment as required by manufacturer. Verify location and characteristics of all equipment shown on plans and in specifications and size circuits accordingly. All conductors and conduits to comply with NEC Article 250 and Article 310.

n. Equipment, instruments, controllers, VFD's, conduits and related appurtenances are shown in approximate locations. Contractor shall field select optimum location and where necessary, relocate up to ten (10) feet from location shown on plans to accommodate installation, at no additional cost to Owner.

2.0 PRODUCTS

2.1 MATERIALS

a. All materials provided under all sections of the specifications shall be new and the standard products of manufacturers regularly engaged in the production of such equipment. All materials shall conform to the National Electrical Code and shall be approved and listed by the Underwriters' Laboratories. Materials described by manufacturer's name and catalog number are selected to set a definite standard of design and quality to be required. There is not any intention to discriminate against a product of another manufacturer which is equally durable in construction, similar in design, and will serve the purpose for which it is intended. Within 30 days after award of the contract and before any materials and equipment are placed on order, the Contractor shall submit to the Engineer for approval a complete list including catalog numbers and descriptive matter, of all materials and

equipment he proposes to provide.
b. Materials and equipment specifications are general in coverage and may contain reference to construction items that apply in only particular situations and may not apply as a general rule for materials installed on this project.

c. Outdoor equipment shall not have exposed devices or controls, unless specifically called for on plans. The outer door shall cover all such items. No see thru windows are allowed unless specifically approved. All outer doors to have locking hasp. Keyed handles only acceptable where specifically approved. All NEMA 4X enclosure doors to have **quick release** latches.

d. All PLC's, controllers, VFD's, instruments and electronic equipment installed outdoors or in unconditioned spaces shall have means of cooling to allow satisfactory operation in local environment and at conditions required by equipment manufacture specification.

e. All control Panels and Motor Control Centers that are not a standard manufacture, off the shelf project shall be manufactured in accordance with plans and specifications with high quality materials and components and shall bear a U.L. listed label or, be constructed by a U.L. listed shop.

2.2 PLANS AND SPECIFICATIONS

a. Electrical plans and specifications are not intended to discriminate against any particular manufacturer. Specific values shown for a particular manufacturer's product may vary slightly for another product. The Electrical Engineer reserves the right to interpret the electrical specifications and to make judgement as to acceptance of a product, regardless of minute details in the specifications or on the plans.
b. Specifications shall be reviewed for applicability of materials under certain conditions and in certain environments and, where not shown otherwise on plan drawings. These application directions shall be adhered to.

c. Where a particular reference on drawing plans does not conform to standard acceptable construction methods for a particular type project, the Contractor shall immediately notify the Engineer and request a clarification before ordering materials or starting construction.

d. Plans are general in nature and may not show minute details of existing conditions or proposed work. Existing conditions may include undocumented buried pipes, conduits and structures that lie in the route, or at location, of equipment or conduit installation required for this project. These uncertainties shall be accounted for in the Contractors Bid. Contractor shall adjust conduit routes, equipment pads and equipment mountings, as required, for a satisfactory installation for the conditions imposed and at no additional cost to the Owner.

e. Electrical site plan drawings shall only be scaled when "Scalable Drawing" appears on the drawing sheets.

3.0 EXECUTION

3.1 WORKMANSHIP

All wiring shall be installed in accordance with current NEC and local codes. Field select routing of conduits to avoid underground piping, conduit or structures that may be shown on plans. Adjust route of electrical conduits and ductbanks below proposed or existing buried piping. Provide minimum 24" clearance vertically and horizontally. This work shall be performed in a satisfactory manner and at no additional cost to Owner.

A fish wire shall be left in all conduits in which the permanent wiring is not installed.

All fixtures, switch, and receptacle locations shall be approved by Engineer.

Refer to other sections of this specification for controls. Under this section of the specifications, the Contractor shall install the control devices and provide control wiring switches, outlet boxes, and shall make all final connections. Control wiring and interlocks shall conform to wiring diagrams furnished by equipment manufacturers.

The Contractor shall provide services of his Engineer or a factory trained technician to instruct plant operating personnel for a period of at least one (1) full day after completion of the contract work.

3.2 EXCAVATION AND BACKFILL

All underground conduits shall be buried to a minimum depth of 24-inches below finished grade. All trenches shall be uniform width and shall be backfilled and compacted to 95% that of original density. Any damage to underground conduits caused by other Contractors shall be repaired by this Contractor and shall be compensated accordingly by the party or parties responsible for the damage.

3.3 CLEAN UP

The Contractor shall upon completion of the work, remove all materials, empty containers, and any other materials that are not incorporated into the work.

- - o O o - -

1.0 GENERAL

1.1 SECTION INCLUDES

a. Specification for conduit, fittings and bodies.

1.2 REFERENCES

a. American National Standards Institute (ANSI).

1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated.

2. ANSI C80.4: Fittings for Rigid Metal Conduit.

b. Federal Specifications.

1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.

2. W-C-1094: Conduit and Conduit Fittings Plastic, Rigid.

3. WW-C-566C: Flexible Metal Conduit.

4. WW-C-581D: Coatings on Steel Conduit.

c. National Electrical Manufacturers Association (NEMA).

1. NEMA RN1: Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.

d. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC).

e. Underwriters' Laboratories (UL).

1. UL 1: Flexible Metal Electrical Conduit.

2. UL 6: Rigid Metal Electrical Conduit.

3. UL 514B: Fittings for Conduit and Outlet Boxes.

4. UL 651: Schedule 40 and 80 Rigid PVC Conduit.

5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.

6. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.

1.3 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

1. Manufacturer's cut sheets, catalog data, with selected products clearly marked.

2. Installation, terminating and splicing procedure.

3. Instruction for handling and storage.

4. Dimensions and weight.

1.4 QUALITY ASSURANCE

a. Tests.

1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1.

2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.

3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A.

1.5 DELIVERY STORAGE AND HANDLING

a. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.

b. Store conduit above ground on racks to prevent corrosion and entrance of debris.

c. Protect plastic conduit from sunlight.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Rigid Steel Conduit.

1. Allied Tube and Conduit
2. Triangle Wire and Cable, Inc.
3. Wheatland Tube Company

b. PVC Coated Steel Conduit.

1. Occidental Coating Company (O-Cal Blue)
2. Robroy Industries, Inc. (Rob-Roy Red)

c. PVC Rigid Conduit.

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

d. Conduit Fittings and Bodies.

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

e. Liquidtight Flexible Conduit.

1. Anamet, Inc.

2. Electriflex Company

3. Triangle Wire and Cable, Inc.

2.2 MATERIALS AND EQUIPMENT

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

b. Conduit and Fittings

1. Rigid Steel Conduit and Fittings.

(a) Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581D, and NEC Article 346-15.
(b) Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.
(c) Fittings, bodies, and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C.

2. PVC-Coated Rigid Steel Conduit and Fittings.

(a) PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN1 (Type A). Rigid steel galvanized conduit and fittings before coating shall conform to Federal Specification WW-C-581D, ANSI C80.1, and UL 6. Conduit bodies shall conform to UL 514B and Federal Specification W-C-58C. Provide sufficient coating for touch up after installation.
(b) PVC-coated couplings shall be of the ribbed type.
(c) Condulet covers shall have encapsulated stainless steel thumb screws.
(d) Condulets and covers shall be of mallable iron or feraloy material before coating.
(e) PVC coating shall be a minimum of 2 mil thickness on the interior of the conduit and the interior of fittings, condulets, covers and bodies.

3. Flexible and Liquidtight Flexible Metal Conduit and Fittings.

   (a) Use liquidtight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C.
   (b) Fittings used with liquidtight flexible metal conduit shall be the PVC- coated type and of such design as to thoroughly ground the conduit to the fittings, and through it to the box or enclosure to which it is attached.
   (c) Flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-4 (a&b), and Federal Specification W-C-586C.

4. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-A, and NEC Article 347-17 for above ground and underground installation. Conduit shall be schedule 80, unless shown or noted otherwise on drawings or in other specifications.

3.0 EXECUTION

3.1 PREPARATION

a. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types and routing shown.

b. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.

c. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.

d. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

3.2 INSTALLATION

a. Install PVC-coated conduits in all outdoor locations at wastewater facilities, inside valve vaults; in wet well slabs, in corrosive and wet environments and, where specifically noted on drawings.

b. Install rigid galvanized steel (RGS) conduits in dry inside locations and in all outdoor locations for water facilities and, where specifically noted otherwise on drawings.

c. Install PVC conduits in duct banks. For stub-ups, use PVC-coated rigid steel elbows or rigid steel elbows as applicable in A and B above or where specifically noted on drawings.

d. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'-0" in passageways.

e. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed.

f. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes.

g. Not more than 3 equivalent 90 degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

h. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may he drawn without damage to the insulation. Make threaded connections wrench tight.

i. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials.

j. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks.

k. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

l. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.

m. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign mater into the conduit system by properly capping terminations.

n. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" condulet equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.

o. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.

p. Where conduit terminates in sheet metal enclosures and where no threaded hubs are provided, fit the conduit with double locknuts and bushings. Sheet metal enclosures located outside or in any other wet, damp or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure.

q. Provide flexible metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment unless shown otherwise on Drawings.

r. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the Drawings. Certain walls, as indicated on the Drawings, require environmental (air-tight) seals; seal as shown.

s. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area, as shown on Drawings. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well.

t. Unless otherwise indicated on the Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.

u. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.

v. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

w. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.

x. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit.

y. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet.

z. The means of fastening conduit to supports shall be: by one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.

aa. Support conduit runs with conduit clamps, hangers, straps and metal framing channel attached to structural steel members. Conduits of 1-1/2 inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 3/16 stainless steel.

bb. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

cc. Size and space embedded conduits in structural slabs in accordance with the Uniform Building Code. Conduits should occupy no more than one-third the thickness of the slab and should not be closer than 3 times the largest diameter on center without additional reinforcement.

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1.0 GENERAL

1.1 SECTION INCLUDES

a. Specifications for 600-volt building wire and cable.

1.2 REFERENCES

a. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 310 - Conductors for General Wiring.

b. Underwriter's Laboratories (UL)

1. UL 83: Thermoplastic Insulated Wires and Cables

2. UL 1063: Machine Tool Wires and Cables

c. American Society for Testing and Materials (ASTM)

1. ASTM B3: Soft or Annealed Copper Wires

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

d. Insulated Cable Engineers Association (ICEA), ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

1.3 SUBMITTALS

a. Submit the following for Engineer's approval.

1. Manufacturer's cut sheets and catalog data

2. Instruction for handling and storage

3. Dimensions and weight

1.4 QUALITY ASSURANCE

a. Tests. Cable shall meet all the requirements of Part 6 of ICEA S-61-402.

1.5 DELIVERY, STORAGE, AND HANDLING

a. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. American Insulated Wire Corporation

b. Carol Cable Company, Inc.

c. General Cable Company

d. Okonite Company

e. Rome Cable Company

f. Triangle Wire and Cable, Inc.

g. Service Wire Company

2.2 MATERIALS AND EQUIPMENT

a. Design. Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90 degrees C in dry locations and 75 degrees C in wet locations while installed in underground duct, conduit or in control panels (MTW).

b. Conductors. Provide conductors which are Class B, concentric stranded, annealed un-coated copper with physical and electrical properties complying with ASTM B3 and B8 and Part 2 of ICEA S-61-402.

c. Insulation. Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of Part 3 of ICEA S-61-402. The insulation thickness shall match the dimensions listed in NEC Table 310-13 for type THHN and THWN wire.

d. Wire Marking

1. Wire marking shall be in accordance with NEC Article 310-11 and shall be printed on the wire insulation at 2-foot intervals.

2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color.

e. The single conductor color coding shall be as follows:

System Voltage	A	B	C	Neutral
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey

Motor Control	1.....Black
	2.....Red
	3.....Blue
Ground	.....Green

3.0 EXECUTION

3.1 PREPARATION

a. Complete the cable raceway systems and underground duct banks before installing cables.

b. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

c. Check the length of the cable raceway system against the length of cable on the selected reel.

d. Clean conduits of foreign matter before cables are pulled.

3.2 INSTALLATION

a. Wiring Methods

1. Use wiring methods indicated on the Drawings

2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring were conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels.

3. Do not use solid conductors.

4. Use conductors not smaller than No. 12 AWG stranded for lighting circuits.

5. Use conductors not smaller than No. 14 AWG for control circuits, except when part of a multiconductor cable or internal panel wiring.

6. In general, do not splice conductors unless approved by the Engineer.

7. Splices associated with taps for lighting and control circuits are allowed without approval.

8. Make splices in accessible junction boxes.

9. Use wire nuts with insulated caps for lighting wiring splices. Splice control circuit with insulated crimp connectors.

b. Single Conductor in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.

2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.

c. Single Conductor in Cable Tray

1. Do not install single conductor building wire and cable in cable tray.

d. Preparation for Termination

1. Make 600-volt power cable terminations and splices with heat shrinkable sleeves and seals.

2. Terminal lugs and connectors for all sizes of conductors shall be crimp-on type.

3. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole tongues except in places where termination space is limited.

e. Tests

1. In general, test insulation integrity of the wiring system before terminating.

2. Make sure to disconnect sensitive electronic equipment before testing insulation.

3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.

f. Termination

1. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

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1.0 GENERAL

1.1 SECTION INCLUDES

a. Specifications for device, pull, and junction boxes.

1.2 REFERENCES

a. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).

1. FB1 - Fittings and Support for Conduits and Cable Assemblies

2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

b. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 370 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

c. Underwriters Laboratories (UL):

1. 50 - Safety Cabinets and Boxes

2. 508 - Safety Industrial Control Equipment

3. 514B - Safety Fittings for Conduit and Outlet Boxes

4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas

1.3 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Installation instructions

4. Dimensions and weights

1.4 DELIVERY, STORAGE AND HANDLING

a. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Sheet Metal Boxes

1. Hoffman Industrial Products
2. Pauluhn Electric Manufacturing Company
3. Hennessy
4. Tanco
5. Tejas
6. Circle A.W.

b. Cast Device Boxes

1. Appleton Electric Company
2. Crouse-Hinds, Division of Cooper Industries
3. Killark Electric Manufacturing Company

2.2 MATERIALS AND EQUIPMENT

a. Sheet Metal Boxes

1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet area, NEMA 250 and NEC Article 370.
2. Provide boxes with a stainless steel continuous hinge, closure hasps and all- stainless steel hardware.

3. Furnish the door with neoprene gasket and provision for padlock.

b. Device Boxes

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 370.

2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.

c. Hardware

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

3.0 EXECUTION

3.1 PREPARATION

a. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.2 INSTALLATION

a. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.

b. Install boxes in accordance with NEC Article 370 in locations indicated on the Drawings.

c. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair.

d. Plug unused conduit openings.

e. Make conduit connections to sheet metal boxes with watertight conduit connectors.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Floor boxes and service fittings.
4. Cabinets.
5. Hinged door enclosures.
6. Boxes and fittings for hazardous locations.

1.2 REFERENCES

a. American Society for Testing and Materials (ASTM):

1. ASTM A167-91 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

b. Underwriter's Laboratory (UL):

1. UL 50-88 - UL Standard for Safety Cabinets and Boxes.
2. UL 514A-91 - UL Standard for Safety Metallic Outlet Boxes.
3. UL 514B-89 - UL Standard for Safety Fittings for Conduit and Outlet Boxes.
4. UL 886-85- UL Standard for Safety Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

c. National Electrical Manufacturer's Association (NEMA):

1. NEMA ICS 6-88 - Enclosures for Industrial Control and Systems.
2. NEMA OS 1-89 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

3. NEMA 250-85- Enclosure for Electrical Equipment (1,000 v maximum).

1.3 DEFINITIONS

a. Cabinets: Enclosure designed either for surface or for flush mounting and having frame, or trim in which door or doors may be mounted.

b. Device Box: Outlet box designed to house receptacle device or wiring box designed to house switch.

c. Enclosure: Box, case, cabinet, or housing for electrical wiring or components.

d. Hinged Door Enclosure: Enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with walls of box.

e. Outlet Box: Wiring enclosure where current is taken from wiring system to supply utilization equipment.

f. Wiring Box: Enclosure designed to provide access to wiring systems or for mounting of indicating devices or of switches for controlling electrical circuits.

1.4 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Product Data: Submit for cabinets and enclosures with classification higher than NEMA 1.

c. Shop Drawings: Submit to Engineer for approval.

1.5 QUALITY ASSURANCE

a. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term"NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

2.0 PRODUCTS

2.1 CABINETS, BOXES, AND FITTINGS, GENERAL

a. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for use and location. Provide items complete with covers and accessories required for intended use. Provide gaskets for units in damp or wet locations.

2.2 MISCELLANEOUS MATERIALS AND FINISHES

a. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

b. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

c. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

d. Finishes:

1. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

2. Interior Finish: Where indicated, white baked enamel.

2.3 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

a. General:

1. Conform to UL 514A and UL 514B.

2. Boxes shall be of type, shape, size, and depth to suit each location and application.

b. Steel Boxes: Conform to NEMA OS 1. Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

c. Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.4 PULL AND JUNCTION BOXES

a. General: Comply with UL 50 for boxes over 100 cu in. volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

b. Galvanized Steel Boxes: Flat rolled, code gauge, sheet steel with welded seams. Where necessary to provide rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

c. Stainless-Steel Boxes: Fabricate of stainless steel conforming to Type 302 of ASTM A167. Where necessary to provide rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

d. Cast-Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

e. Boxes Approved for Classified Locations: Cast metal or cast nonmetallic boxes conforming to UL 886 listed and labeled for use in specific location classification, and with specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.5 CABINETS

a. Comply with Plans.

3.0 EXECUTION

3.1 INSTALLATION, GENERAL

a. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

b. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.

c. Sizes shall be adequate to meet current NEC volume requirements, but in no case smaller than sizes indicated.

d. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS

a. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types for each location in conformance with following requirements unless otherwise noted:

1. Interior Dry Locations: Sheet steel, NEMA type 1 for flush mounting and feraloy Type FS or FD cast boxes with threaded conduit hubs for surface mounting.

2. Locations Exposed to Weather or Dampness: Galvanized, cast metal, NEMA Type 3R.

3. Wet Locations: Stainless Steel, NEMA type 4X enclosures.

4. Corrosive Locations: Stainless Steel, NEMA type 4X enclosures.

5. Hazardous (Classified) Locations: NEMA type listed and labeled for location and class of hazard indicated.

b. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location.

3.3 INSTALLATION OF OUTLET BOXES

a. Gasketed Boxes: At following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.

2. Where exposed to moisture laden atmosphere.

3. Where indicated.

b. Mounting: Mount outlet boxes for switches with long axis vertical or as indicated. Mount boxes for receptacles vertically. Gang boxes shall be mounted with long axis horizontal.

c. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

d. Set boxes in concealed conduit runs, flush with wall surfaces, with or without covers as required.

e. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with finished surface.

f. Provide outlet box divider barriers between 277/480 v and 120/240 v devices as required and per current NEC.

3.4 OUTLET BOX LOCATIONS

a. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to minimum.

b. Location of outlets and equipment as shown on Drawings is approximate and exact location to be verified and shall be determined by:

1. Construction or code requirements.

2. Conflict with equipment or other trades.

3. Equipment manufacturer's drawings.

c. Minor modification in location of outlets and equipment considered incidental up to distance of 10 ft with no additional compensation, provided necessary instructions given prior to roughing in of outlet.

d. Mounting heights for devices and equipment to be measured from finished floor to centerline of device unless otherwise noted on Drawings.

3.5 INSTALLATION OF PULL AND JUNCTION BOXES

a. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-in. square by 4-in. deep. Do not exceed 6 entering and 6 leaving raceways in single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed following:

Size of Largest Conductors in Box	Maximum No. of Conductors in Box
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

1. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 in. inside boxes.

2. Size: Provide pull and junction boxes for telephone, signal, instrumentation, control, and other systems at least 50% larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.6 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES (Not Applicable)

3.7 GROUNDING

a. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes grounding conductor, provide grounding terminal in interior of cabinet, box or enclosure.

b. Ground in accordance with Section 16452.

3.8 CLEANING AND FINISH REPAIR

a. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

b. Galvanized Finish: Repair damage using zinc-rich paint recommended by manufacturer.

c. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

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1.0 GENERAL

1.1 SECTION INCLUDES

a. Specifications for wiring devices including:

1. Receptacles.
2. Wall switches.
3. Wall plates and cover plates.

1.2 REFERENCES

a. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):

1. NEMA WD1 - General Purpose Wiring Devices.
2. NEMA WD6 - Dimensional Requirements.

b. Federal Specifications (WC-596F).

c. American National Standards Institute/National Fire Protection Association (NFPA):

1. NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 410, Paragraphs 56, 57 and 58.

1.3 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval:

1. Manufacturer's product literature and specifications including dimensions, weights, certifications and instructions for handling, storage and installation.

1.4 DELIVERY, STORAGE AND HANDLING

a. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling and storage.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Bryant Electric

b. Crouse-Hinds, Arrow Hart Division

c. Hubbel Inc. Wiring Devices Division

d. Leviton Manufacturing Company

e. Pass & Seymour/Legrand.

2.2 MATERIALS AND EQUIPMENT

a. Standards: Conform to NEMA WD1 for general requirements and NEMA WD6 for dimensional requirements.

b. Manufacture devices to heavy-duty industrial specification grade with brown nylon bodies (orange for isolated-ground receptacles) back and side wiring provisions and green-colored grounding screws.

c. Receptacles:

1. Duplex-type receptacles: Rated 20 amps at 120 volts.

2. Contacts: Brass or phosphor bronze.

3. Receptacle grounding system: Extend to the mounting strap unless isolated ground is indicated or required.

4. GFI or GFCI (ground fault circuit interrupter) receptacles: Provide feed-through type with test and reset button.

d. Wall Switches:

1. Toggle switches: Rated 20 amps at 120/277 volts AC rated for both resistive and inductive loads.

2. Contacts: Silver cadmium oxide construction to prevent sticking, welding and excessive pitting.

e. Cover Plates:

1. In outdoor, corrosive and wet areas, provide cover plates of cast metal, gasketed with spring-loaded hinged covers and stainless steel hardware.

2. All other plates: Type 302 stainless steel.

3.0 EXECUTION

3.1 PREPARATION

a. Verify that device boxes are correctly placed.

b. Verify that the correct quantity, size and type of wires are pulled to each device box.

c. Verify that wiring has been checked at both ends.

d. Prepare wire ends for connection to devices.

e. Inspect each wiring device for defects.

3.2 INSTALLATION

a. Install products in accordance with manufacturer's instructions.

b. Install devices plumb and level.

c. Install switches with OFF position down.

d. Install receptacles with grounding pole on top.

e. Connect wiring device grounding terminal to outlet box with bonding jumper.

f. Connect wiring devices by wrapping conductors clockwise around screw terminals.

g. Install cover plates on switch, receptacle and blank outlets in finished areas.

h. Energize and test devices for proper operation.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Identification of electrical materials, equipment, and installations.

1.2 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Product Data:

1. Submit for each type of product specified.

c. Samples:

1. Submit for each color, lettering style, and or graphic representation required for identification materials; samples of labels and signs.

d. Miscellaneous:

1. Schedule of identification nomenclature to be used for identification signs and labels.

1.3 QUALITY ASSURANCE

a. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

b. Comply with ANSI C2.

2.0 PRODUCTS

2.1 RACEWAY AND CABLE LABELS

a. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

b. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.

2. Legend: Indicates voltage.

c. Adhesive Labels: Preprinted, flexible, self adhesive vinyl. Legend is overlaminated with clear, wear and chemical resistant coating.

d. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.

e. Colored Adhesive Tape: Self adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. wide (0.08 mm thick by 25 to 51 mm wide).

f. Underground Line Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with following features:

1. Size: Not less than 6 in. wide by 4 mils thick (152 mm wide by 0.102 mm thick).

2. Compounded for permanent direct burial service.

3. Embedded continuous metallic strip or core.

4. Printed Legend: Indicates type of underground line.

g. Tape Markers: Vinyl or vinyl cloth, self adhesive, wraparound type with preprinted numbers and letters.

h. Aluminum, Wraparound Marker Bands: Bands cut from 0.014 in. (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

i. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.

j. Aluminum Faced Card Stock Tags: Wear resistant, 18 point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 in. (0.05 mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

k. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 in. (51 by 51 mm) by 0.05 in. (1.3 mm).

2.2 ENGRAVED NAMEPLATES AND SIGNS

a. Manufacturer's Standard Products: Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

b. Engraving stock, melamine plastic laminate, 1/16 in. (1.6 mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8 in. (3.2 mm) thick for larger sizes.

1. Engraved Legend: Black letters on white face.

2. Punched for mechanical fasteners.

c. Baked Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4 in. (6.4 mm) grommets in corners for mounting.

d. Exterior, Metal Backed, Butyrate Signs: Wear resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396 in. (1 mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4 in. (6.4 mm) grommets in corners for mounting.

e. Fasteners for Plastic Laminated and Metal Signs: Self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, flat washers and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

a. Cable Ties: Fungus-inert, self extinguishing, 1 piece, self locking, Type 6/6 nylon cable ties with following features:

1. Minimum Width: 3/16 in. (5 mm).

2. Tensile Strength: 50 lb (22.3 kg) minimum.

3. Temperature Range: Minus 40 to 185° F (Minus 4 to 85° C).

4. Color: As indicated where used for color coding.

b. Paint: Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

3.0 EXECUTION

3.1 INSTALLATION

a. Install identification devices according to manufacturer's written instructions.

b. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

c. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

d. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

e. Self Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

f. Identify feeders over 600 V with "DANGER-HIGH VOLTAGE" in black letters 2 in. (51 mm) high, stenciled with paint at 10 ft (3 m) intervals over continuous, painted orange background. Identify following:

1. Entire floor area directly above conduits running beneath and within 12 in. (305 mm) of basement or ground floor that is in contact with earth or is framed above un-excavated space.

2. Wall surfaces directly external to conduits concealed within wall.

3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.

4. Entire surface of exposed conduits.

g. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime Surfaces: For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.

3. Apply one intermediate and one finish coat of silicone alkyd enamel.

4. Apply primer and finish materials according to manufacturer's instructions.

h. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of systems listed below for identification.

1. Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each color band 2 in. (51 mm) wide, completely encircling conduit, and place adjacent bands of 2 color markings in contact, side by side.

2. Locate bands at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) in congested areas.

3. Colors: As follows:

   (a) Fire Alarm System: Red.
   (b) Fire Suppression Supervisory and Control System: Red and yellow.
   (c) Combined Fire Alarm and Security System: Red and blue.
   (d) Security System: Blue and yellow.
   (e) Mechanical and Electrical Supervisory System: Green and blue.
   (f) Telecommunications System: Green and yellow.

i. Install Caution Signs for Enclosures Over 600 V: Use pressure sensitive, self-adhesive label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover.

j. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Pressure sensitive, self adhesive plastic label on cover.

2. Concealed Boxes: Plasticized card stock tags.

3. Labeling Legend: Permanent, water proof listing of panel and circuit number or equivalent.

k. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 in. (150 to 200 mm) below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16 in. (400 mm), use single line marker.

1. Install line marker for underground wiring, both direct buried and in raceway.

l. Color Code Conductors: Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.

1. Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.

   (a) Colored, pressure sensitive plastic tape in half lapped turns for distance of 6 in. (150 mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1 in. (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.

   (b) Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 in. (76 mm) from terminal and spaced 3 in. (76 mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

System Voltage	A	B	C	Neutral
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey
Motor Control	1	Black		
	2	Red		
	3	Blue		
Ground		Green		

m. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4 in. (6.4 mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Fasten tags with nylon cable ties; fasten bands using integral ears.

n. Apply identification to conductors as follows:

1. Conductors to Be Extended in Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.

3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color coding, or cable marking tape.

o. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8 in. (9 mm) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

p. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of text with 1/2 in. (13 mm) high lettering on 1 1/2 in. (38 mm) high label; where 2 lines of text are required, use lettering 2 in. (51 mm) high. Use black lettering on white field. Apply labels for each unit of following categories of equipment.

   (a) Panelboards, electrical cabinets, and enclosures.
   (b) Access doors and panels for concealed electrical items.
   (c) Electrical switchgear and switchboards.
   (d) Electrical substations.
   (e) Motor control centers.
   (f) Motor starters.
   (g) Push button stations.

(h) Power transfer equipment.
(i) Contactors.
(j) Remote controlled switches.
(k) Dimmers.
(l) Control devices.
(m) Transformers.
(n) Inverters.
(o) Rectifiers.
(p) Frequency converters.
(q) Battery racks.
(r) Power generating units.
(s) Telephone switching equipment.
(t) Clock/program master equipment.
(u) Call system master station.
(v) TV/audio monitoring master station.
(w) Fire alarm master station or control panel.
(x) Security monitoring master station or control panel.

2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

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1.0 GENERAL

1.1 SECTION INCLUDES

a. Underground electrical duct banks.

1.2 REFERENCES

a. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B.

1.3 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Catalog cut sheets of the ducts and spacers.

1.4 DELIVERY, STORAGE AND HANDLING

a. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling.

b. Clearly mark packages or crates stating that the material is for electrical duct banks only.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Thomas and Betts.

b. Underground Devices Inc.

c. Walker Division, Butler Manufacturing Company.

2.2 MATERIALS AND EQUIPMENT

a. Conduit. Construct ducts using schedule 80 rigid PVC conduit. Refer to Section 16111 - Conduit, Fittings and Bodies.

b. Spacers. Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements.

c. Concrete. Use steel reinforced, red concrete as duct encasement.

3.0 EXECUTION

3.1 PREPARATION

a. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities.

b. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work.

c. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete.

d. Be prepared for inspection of the duct banks before reinforcing rod is installed.

e. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware.

f. Provide 24-hour notice to Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.2 INSTALLATION

a. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project.

b. Make duct bank installations and penetrations through foundation walls watertight.

c. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 2-inch minimum concrete separation between the outer surfaces of the conduits.

d. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 pounds per cubic yard to concrete used for envelopes for easy identification during subsequent excavation.

e. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.

f. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.

g. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

h. Make bends of 30 degrees or more using rigid galvanized steel.

i. Reinforce duct banks throughout, where indicated on the Drawings.

1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 5 tie-bars transversely placed at 18-inch maximum longitudinal intervals.

2. Maintain a maximum clearance of 2 inches from bars to the edge of the concrete encasement.

j. Where ducts enter structures such as handholes, manholes, pullboxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.

k. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or contribute to corrosion of ducts or prevent adequate compaction of fill.

l. Install a bare stranded copper duct bank ground in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system.

m. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Repull the rag or sponge swab until the swab emerges clean.

n. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

o. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 - Electrical Identification.

p. For manholes and pull boxes below grade, install wire racks to support cables properly around the perimeter and keep them dry.

q. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings.

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1.0 GENERAL

1.1 SUMMARY

a. Section includes:

1. Solid grounding of electrical systems and equipment.

2. Basic requirements for grounding for protection of life, equipment, circuits, and systems.

3. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.2 REFERENCES

a. American Society for Testing and Materials (ASTM):

1. B3-90 - Standard Specification for Soft or Annealed Copper Wire.

2. B8-90 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

3. B33-91 - Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

4. E699 E1-79 - Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E-6.

b. National Fire Protection Association (NFPA):

1. NFPA 78-89 - Lightning Protection Code.

c. Underwriter's Laboratories (UL)

1. 467 84 - UL Standard for Safety Grounding and Bonding Equipment.

1.3 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Test Results:

1. Report of field tests and observations certified by Contractor.

1.4 QUALITY ASSURANCE

a. Items provided under this section shall be listed OR labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

2.0 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

a. Products: Of types indicated and of sizes and ratings to comply with current NEC. Where types, sizes, ratings, and quantities indicated are in excess of current NEC requirements, more stringent requirements and greater size, rating, and quantity indications govern.

b. Conductor Materials: Copper.

2.2 WIRE AND CABLE CONDUCTORS

a. Comply with Section 16100. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

b. Equipment Grounding Conductor: Green insulated.

c. Grounding Electrode Conductor: Stranded cable.

d. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.

2. Assembly of Stranded Conductors: ASTM B8.

3. Tinned Conductors: ASTM B33.

2.3 MISCELLANEOUS CONDUCTORS

a. Ground Bus: Bare annealed copper bars of rectangular cross section.

b. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.

c. Bonding Strap Conductor/Connectors: Soft copper, 0.05 in. thick and 2 in. wide, except as indicated.

2.4 CONNECTOR PRODUCTS

a. General: Listed and labeled as grounding connectors for materials used.

b. Pressure Connectors: High-conductivity-plated units.

c. Bolted Clamps: Heavy-duty units listed for application.

d. Exothermic Welded Connections: Provide in kit form and select for specific types, sizes, and combinations of conductors and other items to be connected.

2.5 GROUNDING ELECTRODES

a. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.

1. Size: 3/4 inch by 10 feet unless otherwise indicated.

b. Plate Electrodes: Copper plates, minimum 0.10 in. thick, size as indicated.

3.0 EXECUTION

3.1 APPLICATION

a. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and

quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Install separate insulated equipment grounding conductors with circuit conductors.

   (a) Raceway may be used as equipment ground conductor where feasible in non-hazardous areas and permitted by current NEC for lighting circuits and receptacle circuits.
   (b) Install insulated equipment ground conductor in nonmetallic raceways unless designated for telephone or data cables.

b. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicted.

c. Signal and Communications: For telephone, alarm, instrumentation and communication systems, provide #4 AWG minimum green insulated copper conductor in raceway from grounding electrode system to each terminal cabinet or central equipment location.

d. Ground separately derived systems required by NEC to be grounded in accordance with NEC paragraph 250-26.

e. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to grounding electrode as indicated in addition to separate equipment grounding conductor run with supply branch circuit.

f. Connections to Lightning Protection System: Bond grounding conductors or grounding conductor conduits to lightning protection down conductors or grounding conductors in compliance with NFPA 78.

g. Common Ground Bonding With Lightning Protection System:

1. Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode.

2. Use bonding conductor sized same as system ground conductor and installed in conduit.

3.2 INSTALLATION

a. General: Ground electrical systems and equipment in accordance with current NEC requirements except where Drawings or Specifications exceed NEC requirements.

b. Ground Rods:

1. Locate minimum of one-rod length from each other and at least same distance from any

other grounding electrode.

2. Interconnect ground rods with bare conductors buried at least 24 in. below grade.

3. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated.

4. Make connections without damaging copper coating or exposing steel.

5. Use 3/4-inch by 10-ft. ground rods except as otherwise indicated.

6. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.

c. Metallic Water Service Pipe:

1. Provide insulated copper ground conductors, sized as indicated, in conduit from building main service equipment, or ground bus, to main metallic water service entrances to building.

2. Connect ground conductors to street side of main metallic water service pipes by means of ground clamps.

3. Bond ground conductor conduit to conductor at each end.

d. Braided-Type Bonding Jumpers:

1. Use elsewhere for flexible bonding and grounding connections.

e. Route grounding conductors along shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

f. Test Wells: Locate as indicated, and fabricate in accordance with details indicated.

g. UFER Ground:

1. Fabricate with 20 feet of conductor laid lengthwise in excavation for foundation or footings.

2. Install so conductor is within 2 in. of bottom of concrete.

3. Where base of foundation is less than 20 feet in length, coil excess conductor at base of foundation.
4. Bond conductor to reinforcing steel at four locations, minimum.

5. Extend conductor below grade and connect to building grounding grid or grounding electrode.

3.3 CONNECTIONS

a. General: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

2. Make connections with clean bare metal at points of contact.

3. Aluminum to steel connections: stainless steel separators and mechanical clamps.

4. Aluminum to galvanized steel connections: tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

b. Exothermic Welded Connections:

1. Use for connections to structural steel and for underground connections except those at test wells.

2. Install at connections to ground rods and plate electrodes.

3. Comply with manufacturer's written recommendations.

4. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

c. Terminations:

1. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs.

2. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to housing, terminate each conduit with grounding bushing.

3. Connect grounding bushings with bare grounding conductor to ground bus in housing.

4. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

d. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

e. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

f. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make visible indication that connector has been adequately compressed on ground conductor.

g. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.4 OVERHEAD LINE GROUNDING

a. General: Comply with ANSI C2, "National Electrical Safety Code" for "Single-Grounded Systems," using two electrodes in parallel if single electrode resistance to ground exceeds 25 ohms.

b. Ground Rod Connections: Use exothermic welds for underground connections and connections to rods.

c. Lightning Arresters: Separate arrester grounds from other ground conductors.

d. Secondary Neutral and Tank of Transformer: Interconnect and connect to ground.

e. Grounding Conductor Protection: Protect grounding conductors running on surface of wood poles with molding of a type manufactured for this purpose. Extend from grade level up to and through communications and transformer spaces.

3.5 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

a. Manholes and Handholes:

1. Install 3/4-inch by 10-ft. driven ground rod close to wall and set rod depth such that 4 inches will extend above finished floor.

2. Where necessary, install ground rod before manhole is placed and provide No. 1/0 bare tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall.

3. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 in. above to 6 in. below concrete.

4. Seal floor opening with waterproof non-shrink grout.

b. Connections at Manholes:

1. Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to ground rod or ground conductor.

2. Make connections with minimum No. 4 AWG stranded hard-drawn copper wire.

3. Train conductors plumb or level around corners and fasten to manhole walls.

4. Connect to cable armor and cable shields by means of tinned terminals soldered to armor or shield, or as recommended by manufacturer of splicing and termination kits.

c. Grounding System: Ground non-current-carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

3.6 FIELD QUALITY CONTROL

a. Test:

1. Subject completed grounding system to megger test at each location where maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells.

2. Measure ground resistance without soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

3. Perform tests by 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."

b. Ground/resistance maximum values shall be as follows:

1. Equipment rated 500 kVA and less: 10 Ohms.

2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.

3. Equipment rated over 1000 kVA: 3 Ohms.
4. Unfenced substations and pad-mounted equipment: 5 Ohms.

5. Manhole grounds: 10 Ohms.

c. Deficiencies: Where ground resistances exceed specified values, notify Engineer, and if directed by Engineer, modify grounding system to reduce resistance values. Where measures are directed that exceed those indicated, provisions of Contract covering changes will apply.

d. Report: Prepare test reports, certified by testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.7 RESTORATION

a. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

b. Where sod has been removed, replace it as soon as possible after backfilling is completed.

c. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition.

d. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

e. Restore disturbed paving as indicated.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. General purpose, dry type transformers.
2. Drive isolation transformers.
3. Control and signal transformers.

1.2 REFERENCES

a. American National Standards Institute, Inc./Institute of Electrical and Electronics Engineers (ANSI/IEEE):

1. ANSI/IEEE C2-90 - National Electrical Safety Code.
2. ANSI/IEEE C57.12.80-78 - Standard Terminology for Power and Distribution Transformers.

b. National Electrical Manufacturers Association (NEMA):

1. NEMA LA 1-86 - Surge Arrestors.
2. NEMA ST 1-88 - Specialty Transformers (Except General-Purpose Type).
3. NEMA ST 20-86 - Dry-Type Transformers for General Applications.

c. Underwriters Laboratories, Inc. (UL):

1. UL 486A-80 - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
2. UL 506-89 - Specialty Transformers.

1.3 SUBMITTALS

a. Submit the following for Engineer's approval.

b. Product Data:

1. Dimensional plans and sections.

2. Elevations showing minimum clearances.

3. Installed devices.

4. Materials list.

5. Weights.

6. Wiring diagrams.

7. Manufacturer's nameplate data and electrical ratings.

c. Product Test Reports:

1. Certified copies of manufacturer's design and routine factory tests required by reference standards.

2. Submit after manufacture of transformer and before installation.

1.4 QUALITY ASSURANCE

a. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

c. ANSI/IEEE Compliance: Comply with applicable requirements of ANSI/ IEEE standards, including ANSI/IEEE C2 and C57.12.80.

2.0 PRODUCTS

2.1 MANUFACTURERS

a. Square D.

b. General Electric.

c. Or equal.

2.2 TRANSFORMERS, GENERAL

a. Transformers:

1. Factory-assembled and tested, air-cooled units of types specified, having characteristics and ratings as indicated.

2. Design unit for 60 Hz service.

b. Cores: Grain-oriented, non-aging silicon steel.

c. Coils: Continuous windings without splices, except for taps.

d. Internal Coil Connections: Brazed or pressure type.

e. Bolt coil/core to bottom of enclosure for transformers larger than 15 kVA.

1. Isolated by rubber, vibration-absorbing mounts.

2. Metal-to-metal contact between coil/core and enclosure not allowed.

f. Provide copper windings.

g. Nameplates: Provide metal nameplate listing manufacturer's name, serial number, type, class, kVA voltage, frequency, and showing internal wiring diagram.

h. Sound Level: Minimum 3 dB less than sound levels for transformer type and size indicated when factory-tested in accordance with NEMA ST 20.

2.3 GENERAL PURPOSE, DRY TYPE TRANSFORMERS

a. Comply with NEMA ST 20.

b. Windings: 2-winding type. 3-phase transformers shall use 1 coil/ phase in primary and secondary.

c. Transformers shall have following features and ratings.

1. Enclosure: Indoor, ventilated unless otherwise shown on Drawings.

2. Insulation Class: 185°C or 220°C class for transformers 15 kVA or smaller; 220°C class for transformers larger than 15 kVA.

3. Insulation Temperature Rise: 80°C maximum rise above 40°C for 15 kVA and larger; 115°C maximum rise above 40°C below 15 kVA.

4. Taps: For transformers 3 kVA and larger, full capacity taps in high voltage winding as follows.

(a) 3 through 10 kVA: Two 5% taps below rated high voltage.
(b) 15 through 500 kVA: Six 2-1/2% taps, 2 above and 4 below rated high voltage.
(c) 750 through 1,000 kVA: Four 2-1/2% taps, 2 above and 2 below rated high voltage.

d. Accessories: Following accessory items are required where shown on Drawings.

1. Surge Arresters: Low voltage type, factory-installed and connected to high voltage terminals; complying with NEMA LA 1.

2. Wall Mounting Brackets: Manufacturer's standard brackets for transformers sized up to 75 kVA where wall mounting indicated.

3. Electrostatic Shielding: Insulated metallic shield between primary and secondary windings. Connect to terminal marked "shield" for grounding connection, where applicable.

2.4 DRIVE ISOLATION TRANSFORMERS

a. Comply with requirements of NEMA ST 1 and UL 506, except as specified below.

b. Ratings:

1. As indicated and continuous duty.

2. Minimum kVA: 130% of motor nameplate hp.

c. Type:

1. Self-cooled, 2-winding, dry type especially designed for application, with special coil bracing to withstand electro-mechanical forces involved.

2. 3-ph transformers shall use 1 coil/phase in primary and secondary.

d. Transformers shall have following features and ratings.

1. Enclosure: Indoor, ventilated unless otherwise shown on Drawings.

2. Insulation Class: 220°C class.

3. Insulation Temperature Rise: 115°C at 115% of rating.

4. Taps: Two 5% full capacity taps, 1 above and 1 below rated high voltage.

5. Temperature Sensing Device: Thermistor embedded in coil with leads brought out to terminal board.

2.5 CONTROL AND SIGNAL TRANSFORMERS

a. Comply with NEMA ST 1 and UL 506.

b. Ratings:

1. As indicated and for continuous duty.

2. Where rating not indicated, provide 125% of load.

c. Type: Self-cooled, 2-winding dry type.

d. Enclosure: Indoor, except as indicated.

3.0 EXECUTION

3.1 INSTALLATION

a. Arrange equipment to provide adequate spacing for cooling air circulation.

b. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values not indicated, use those specified in UL 486A and 486B.

c. Install wall-mounted transformers on prefabricated brackets designed for purpose.

d. Install floor-mounted transformers on 4-in. concrete housekeeping pad.

e. Touch up scratched or marred surfaces to match original finish.

f. Identify transformers as specified herein.

g. Install lightning arresters as shown on Drawings.

3.2 GROUNDING

a. Ground in accordance with Section 16452.

3.3 FIELD QUALITY CONTROL

a. Test and permanently record as follows.

1. Prior to energization of transformers, test phase-to-phase and phase-to-ground insulation resistance levels.

2. Test transformers for continuity of circuits and short-circuits.

3.4 ADJUSTING

a. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.5 CLEANING

a. Upon completion of installation, inspect interiors and exteriors of accessible components.

1. Remove paint splatters and other spots, dirt, and construction debris.

2. Touch up scratches and mars of finish to match original.

3.6 PROTECTION

a. Temporary Heating: Comply with manufacturer's written recommendations within enclosure of each transformer throughout periods during which equipment is not in a space continuously under normal control of temperature and humidity.

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1.0 GENERAL

1.1 SCOPE

This section specifies motor control panel for use on a three-phase power system. Furnish and install motor control panel that conform to NEMA, Class II, Type C construction.

1.2 REFERENCE STANDARDS

The motor control panels must conform to requirements in the latest edition of the following publications:

a. ANSI C19.1959, Industrial Control Apparatus.

1.3 ACCEPTABLE MANUFACTURERS

a. In order to secure proper coordination and operation of the control functions, the Contractor must select a single automatic controls manufacturer as part of the contract requirements. The controls manufacturer will be fully responsible for proper setting and adjustment of control, alarm and indicating units.

b. The manufacturer selected must be experienced with the installation of motor control panels. Acceptable component manufacturers are Westinghouse, Square D., General Electric, and Allen Bradley or approved equal.

2.0 PRODUCTS

2.1 ENCLOSURE

a. Construction.

(1) Fabricate the enclosure from sheet metal to form a floor-mounted unit using not less than 14 H.S.G. cold-rolled stainless steel. Weld joints and grind smooth before finishing. Seal construction joints to impede entry of dust or moisture. Enclosure shall be NEMA 4X rated.

(2) Provide a single gasketed external door with substantial hinges installed in the vertical axis permitting it to swing open. Provide toggle latches around the perimeter of the door. Provide a pad lockable handle. Keyed locking handles are not acceptable.

(3) Provide hinged intercover panel to cover breakers, motor starters and relays. Each circuit breaker shall be provided a rod operated disconnect with interlocks to prevent opening of the hinged panel or panels unless breakers are in the off position.

b. Finish. The enclosure shall be constructed of 304 stainless steel.

c. Nameplates. Provide nameplates as specified in the section titled Electrical General Provisions.

(1) On the MCP prominently display a permanent nameplate giving the following information:

(a) Manufacturer

(b) Date of manufacture

(c) Voltage

(d) Phases

(e) Hertz

(f) Continuous current rating

2.2 DISCONNECT SWITCHES

a. Type. Provide circuit breaker disconnect switches as indicated. Make provision for padlocking in the open position.

b. Contacts. Quick-make, quick-break type.

c. Operators. Provide convenient and safe switch operators mounted through the panel door and permitting operating of the switch with the door closed.

d. Acceptable Manufacturers. Cutler-Hammer, General Electric, ITE, Square D, Westinghouse or approved equal.

2.3 COMBINATION STARTERS

a. Type. NEMA design Motor Circuit Protector type FVNR as noted. IEC components are not acceptable.

b. Overload Relays. The unit will include three (3) ambient-compensated, bimetallic thermal overload relays, set relays at the maximum value allowed by NEC Section 430-32, based on full-load amperes given on the motor nameplate.

c. Contactors. Size contactors according to NEMA standards. Provide three (3) main poles, and the number and type of auxiliary contacts to perform the required functions. Use double break contacts of silver.

d. Acceptable Manufacturers. General Electric, ITE, Square D, Westinghouse, Cutler-Hammer or approved equal.

2.4 PHASE MONITORING RELAYS

a. Type. Provide a 600-volt, industrial-rated, phase failure relay for motor circuits, as shown. Use a shunt-type device which functions independent of line current.

b. Operation. The relay will monitor line-to-line voltage through three (3) potential sensors. At 10 percent voltage unbalance, or on phase reversal, or a low phase potential, the relay will open the control circuit. Provide a 0.2-second time delay on trip-out to prevent nuisance tripping form transient voltage fluctuations.

c. Fuses. Provide one (1) fuse per phase ahead of the relay.

d. Phase Monitoring. For phase monitoring, use Diversified Electronics Cat. No. SLA-460-ALE.

2.5 CONTROLS

Selector switches and indicating lights shall be of same manufacture.

a. Switches.

(1) Type. Provide heavy-duty, oil-tight control switches, complete with factory legend plates.

(2) Acceptable Manufacturers. Cutler-Hammer, General Electric, Square D, Westinghouse, ITE or approved equal.

b. Indicating Lights.

(1) Type. Provide push-to-test, oil-tight indicating lights as manufactured by Cutler-Hammer, Square D, General Electric, ITE, Westinghouse or approved equal.

(2) Lamps. Use 3-watt, 120-volt lamps. Connect in series with a l000 ohm, 2-watt resistor.

(3) Lenses. Provide colored glass lenses to give the following indications:

Indication	Color
Equipment running	Green
Power On	Amber
Alarm	Red

c. Control Wiring. Controls, auxiliary equipment and circuits, including spare contacts, must be factory wired. Wiring must be continuous without splices from terminal to terminal. Identify terminal blocks with appropriate labels. Supply spare terminal blocks for points of external wiring connections.

d. Control Power Transformer. Provide one 480 volt to 120 volt dry type control transformer and associated circuit breakers as indicated on the drawings.

e. Control Relays. Control relays and wiring scheme is shown on the schematic wiring diagram for MCPI. Relay types and ratings are noted. All contacts or coils shall be rated for 120 volt, 60 hertz service.

2.6 SUBMITTALS

Submit complete electrical and dimensional drawings for the Motor Control Panel including control schematic.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.2 REFERENCES

a. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE C62.1-89 - Standard for Gap Silicon-Carbide Surge Arrestors for AC Power Circuits.

2. IEEE C62.11-87 - Standard for Metal-Oxide Surge Arrestors for AC Power Circuits.

b. National Electrical Manufacturers Association (NEMA):

1. NEMA PB.1-90 - Panelboards.

2. NEMA PB1.1-91 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 volts or less.

c. Underwriter's Laboratory (UL):

1. UL 486A-86- Wire Connectors and Soldering Lugs for Use with Copper Conductors, 7th Edition.

2. UL 870-85 - Wireways, Auxiliary Gutters, and Associated Fittings, 5th Edition.

1.3 DEFINITIONS

a. Load Center: Panelboard with thermal magnetic circuit-breaker branches, primarily of plug-in type, designed for residential and light commercial projects, operating at 240 V and below, available in both single and 3-phase versions, and equipped with combination flush/surface mounting trim.

b. Overcurrent Protective Device (OCPD): Device operative on excessive current that causes and maintains interruption of power in circuit it protects.

1.4 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Product Data:

1. For each type panelboard, accessory item, and component specified.

2. Identification materials.

c. Shop Drawings:

1. Dimensioned plans, sections, and elevations.

2. Tabulations of installed devices, major features, and voltage rating.

3. Include:

(a) Enclosure type with details for types other than NEMA Type 1.
(b) Bus configuration and current ratings.
(c) Short-circuit current rating of panelboard.
(d) Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

d. Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field- installed wiring.

e. Report of field tests and observations in accordance with this section.

f. Maintenance and Operations Data:

1. Include instructions for testing circuit breakers.

1.5 QUALITY ASSURANCE

a. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Terms "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

2.0 PRODUCTS

2.1 MANUFACTURERS

a. Square D Co.

b. General Electric

c. Eaton Corp.

d. Or equal.

2.2 PANELBOARDS, GENERAL REQUIREMENTS

a. Construction in accordance with NEMA PB1.

b. Overcurrent Protective Devices (OCPDs):

1. Provide type, rating, and features as indicated.

2. Comply with Section 16475 with OCPDs adapted to panelboard installation.
3. Tandem circuit breakers shall not be used.

4. Multiple breakers shall have common trip.

c. Enclosures:

1. Cabinets, flush or surface mounted as indicated. NEMA Type 1 enclosure, except where other enclosure requirements are indicated.

d. Front:

1. Secure to box with concealed trim clamps except as indicated.

2. Front for surface-mounted panels shall be same dimensions as box.

3. Fronts for flush panels shall overlap box except as otherwise specified.

e. Directory Frame: Metal, mounted inside each panel door.

f. Bus: Hard drawn copper of 98 percent conductivity.

g. Main and Neutral Lugs: Mechanical type.

h. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

i. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.

j. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

k. Special Features: Provide following features for panelboards as indicated.

1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

2. Split Bus: Vertical bus of indicated panels divided into two vertical sections with connections as indicated.

3. Extra Gutter Space: Dimensions and arrangement as indicated.

4. Auxiliary Gutter: Conform to UL 870.

5. Column-Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.

6. Subfeed: OCPD or lug provision as indicated.

7. Feed-Through Lugs: Sized to accommodate feeders indicated.

8. Surge Arresters: For panelboards as indicated on Plans.

(a) Comply with IEEE C62.11 or IEEE C62.1.

(b) Description: Coordinate impulse sparkover voltage with system circuit voltage and provide factory mounting with UL-recognized mounting device.

2.3 LOAD CENTERS

a. Provide load-center-type panelboards only where specifically indicated.

b. OCPDs: Plug-in full module (nominal 1-in. width) circuit breaker.

c. Circuit Breakers for Switching Lights at Panelboards: Indicated type SWD.

d. Circuit Breakers for Equipment Marked HCAR Type: Indicated HCAR type.

e. Interiors: Provide physical means to prevent installation of more OCPDs than quantity for which enclosure was listed.

f. Main, Neutral, and Ground Lugs and Buses: Mechanical connectors for conductors.

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

a. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

b. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.5 DISTRIBUTION PANELBOARDS

a. Branch-Circuit Breakers: Where OCPDs are indicated to be circuit breakers, use bolt-on breakers except circuit breakers 225-ampere frame size and greater may be plug-in type where individual positive locking device requires mechanical release for removal.

b. Doors:

1. In panel front, omit single panelboard door in cabinet front for fusible switch panelboards except as indicated.

2. Secure with vault-type with tumbler lock, all keyed alike.

2.6 ACCESSORY COMPONENTS AND FEATURES

a. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

b. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

c. Spare Fuse Cabinet: Identified, compartmented, lockable steel box or cabinet with compartments suitable for surface mounting on wall.

2.7 IDENTIFICATION

a. General: Provide nameplates for all panelboards.

b. Panelboard Nameplates: Engraved laminated plastic for each panelboard.

3.0 EXECUTION

3.1 INSTALLATION

a. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, and manufacturers' written installation instructions, and approved submittals.

b. Mounting Heights: Top of trim 6 ft 2-in. above finished floor, except as indicated.

c. Mounting:

1. Plumb and rigid without distortion of box.

2. Mount flush panels uniformly flush with wall finish.

d. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.

e. Install filler plates in unused spaces.

f. Provision for Future Circuits at Flush Panelboards:

1. Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.

2. Stub four 1-inch empty conduits into raised floor space or below slab other than slabs on grade.

g. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.

h. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.2 IDENTIFICATION

a. Identify field-installed wiring and components and provide warning signs in accordance with Section 16195.

3.3 GROUNDING

a. Connections: Make equipment grounding connections for panelboards as indicated.

b. Provide ground continuity to main electrical ground bus indicated.

c. Ground in accordance with Section 16452.

3.4 CONNECTIONS

a. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque- tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 FIELD QUALITY CONTROL

a. Perform tests on low-voltage power panelboards and accessories.
b. Upon completing installation of system, perform following tests:

1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests of circuits.

c. Quality Control Program.

1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.

2. Notify Engineer at least one week in advance of testing.

3. Report Testing:

   (a) Report written reports of tests and observations.
   (b) Report defective materials and workmanship and unsatisfactory test results.
   (c) Include records of repairs and adjustments made.

4. Protective Device Ratings and Settings:

   (a) Verify indicated ratings and settings to be appropriate for final system configuration and parameters.
   (b) Where discrepancies are found, recommend final protective device ratings and settings.
   (c) Use accepted ratings or settings to make final system adjustments.

d. Visual and Mechanical Inspection: Include following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction.

3. Check panelboard mounting, area clearances, and alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Perform visual and mechanical inspection and related work for overcurrent protective devices as within this section.

e. Electrical tests: Include following items performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.

2. Ground resistance test on system and equipment ground connections.

3. Test main and subfeed overcurrent protective devices in accordance within this section.

f. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards. Verify by system tests that total assembly meets specified requirements.

3.6 CLEANING

a. Upon completion of installation, inspect interior and exterior of panelboards.

b. Remove paint splatters and other spots, dirt, and debris.

c. Touch up scratches and mars of finish to match original finish.

d. Clean interior of panelboard.

3.7 ADJUSTING

a. Adjust doors and operating mechanisms for free mechanical movement.

3.8 COMMISSIONING

a. Balancing Loads: After Substantial Completion, but before Final Acceptance, conduct load-balancing measurements and circuit changes as follows:

1. Perform measurements during period of normal working load as advised by Owner.

2. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hr services such as Fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. Recheck loads after circuit changes during normal load period. Record load readings before and after changes and submit test records.

4. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Re-balance and recheck as required to meet this minimum requirement.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly used with them.

1.2 REFERENCES

a. National Electrical Manufacturers Association (NEMA).

1. NEMA KS-1-83 - Enclosed Switches.

2. NEMA 250-85 - Enclosures for Electrical Equipment (1000 Volts Maximum).

3. NEMA FU1-86 - Low Voltage Cartridge Fuses.

4. NEMA AB1-86 - Molded Case Circuit Breakers and Molded Case Switches.

b. National Fire Protection Association (NFPA):

1. NFPA 70-90 - National Electrical Code (NEC).

c. Underwriters Laboratory (UL):

1. UL 98-87 - Enclosed and Dead Front Switches.

2. UL 198C-86 - High-Interrupting Capacity Fuses, Current-Limiting Types. Fifth Edition.

3. UL 198E-88 - Class R Fuses. Fourth Edition.

4. UL 486A-80 - Wire Connectors and Soldering Lugs for Use with Copper Conductors. Seventh Edition.

5. UL 489-86 - Molded-Case Circuit Breakers and Circuit-Breaker Enclosures. Seventh Edition.

6. UL 943-85 - Ground-Fault Circuit Interrupters. Second Edition.

7. UL 977-84 - Fused Power-Circuit Devices. Third Edition.

8. UL 198L-88 - UL Standard for Safety D-C Fuses for Industrial Use.

1.3 DEFINITIONS

a. Overcurrent Protective Device (OCPD): Device operative on excessive current that causes and maintains interruption of power in circuit it protects.

b. Ampere-Squared-Seconds: Expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, ampere-squared-seconds during fault current interruption represents energy allowed to flow before fuse or breaker interrupts fault current within its current limiting range.

1.4 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Shop Drawings:

1. Spare fuse cabinet showing dimensions and features including storage provision for fused cartons, where shown on Plans.

c. Product Data:

1. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for protective devices and let-through current curves for those with current limiting characteristics.

2. Include coordination charts and tables and related data.

d. Test Results:

1. Certified reports of field tests and observations.

1.5 QUALITY ASSURANCE

a. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term"NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. Components and Installation:

a. NFPA 70 "National Electrical Code (NEC)."
b. Local codes and ordinances.

c. Single-Source Responsibility: Obtain similar OCPDs from single manufacturer.

1.6 MAINTENANCE

a. Extra Materials:

1. Maintenance Stock, Fuses: For types, voltage, and ampere ratings required, furnish 10% spare fuses, but not less than 1 set of 3 of each kind.

2.0 PRODUCTS

2.1 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL

a. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, and motor control centers; and also as individually enclosed and mounted single units.

b. Enclosures: NEMA 250.

2.2 GENERAL FUSES

a. General: Provide fuses of types, classes, and current ratings as indicated. Voltage ratings shall be consistent with circuits on which used.

b. Fuses for Direct Current Circuits: UL 198L and marked for such use by manufacturer on fuse label.

c. Cartridge Fuse:

1. Manufacturers:

(a) Bussmann Div., Cooper Industries, Inc.

(b) Gould Shawmut.
(c) Littelfuse Inc.

2. NEMA Standard FU1, unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with circuits on which used.

3. Class CC Fuses: UL 198C.

4. Class J Fuses: UL 198C.

5. Class L Fuses: UL 198C.

(a) Current limiting threshold of 10 times current rating or less and time delay of 4 sec at 5 times rating.

6. Class RK1 and RK5 Dual Element Time-Delay Fuses: UL 198E.

7. Class RK1 Fast-Acting Fuses: UL 198E.

2.3 FUSIBLE SWITCHES

a. Manufacturers:

1. Square D Co.

2. General Electric

3. Eaton Corp.

4. Or equal.

b. UL 98 and NEMA KS 1 quick-make, quick-break heavy-duty units.

c. Rating: Load-breaking capacity in excess of normal horsepower rating for switch.

d. Withstand Capability: In excess of let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

e. Operation: By means of external handle.

f. Interlock: Prevents access to switch interior except when in "off" position.

g. Fuse Clips: Rejection type.
h. Padlocking Provisions: For 2 padlocks, whether open or closed.

i. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting where indicated.

j. Enclosure for Switchboard Mounting: Provide individual mounting where indicated.

k. Enclosure for Independent Mounting: NEMA Type 0 as indicated or required to suit environment where located.

2.4 FUSED POWER CIRCUIT DEVICES

a. Manufacturers:

1. Pringle Electric Mfg. Co.

2. Square D Co.

3. Or equal.

b. UL 977, with either bolted-pressure-type or high-pressure contact-type switch.

c. Operation: As indicated.

d. Ground Fault Protection: Integral, self-powered type with mechanical ground fault indicator, test function, adjustable pick-up current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated.

e. Open Fuse Trip Device: Arranged to trip switch open if phase fuse opens.

f. Enclosure for Switchboard Mounting: Suitable for individual mounting.

g. Enclosure for Independent Mounting: NEMA Type 1 enclosure, as indicated or as required to suit environment where located.

h. Minimum Fault Current Rating: As indicated.

2.5 MOLDED-CASE CIRCUIT BREAKERS

a. Manufacturers Except as Indicated:

1. Square D Co.

2. General Electric

3. Eaton Corp.

4. Or equal.

b. UL 489 and NEMA AB 1.

c. Construction: Bolt-in type, except breakers in load-center-type panelboards and breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

d. Characteristics: Indicated frame size, trip rating, number of poles, and short-circuit interrupting capacity rating of 10,000 amperes symmetrical, unless greater rating is indicated on Drawings.

e. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.

f. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values.

g. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

h. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.

i. Enclosure for Independent Mounting: NEMA Type 1 enclosure, as indicated or required to suit environment where located.

j. Combination Circuit Breakers and Ground-Fault Circuit Interrupters: UL 943 arranged for sensing and tripping for ground-fault current in addition to overcurrent and short-circuit current.

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2. Trip Setting for Ground Fault: 4 to 6 milliamperes, listed and labeled as Class A, Type 1 device.

3. Trip Setting for Ground Fault: 30 milliamperes.

k. Current-Limiting Circuit Breakers: Arranged to limit let-through ampere-squared-seconds during fault conditions to value less than ampere-squared-seconds of one-half-cycle wave of prospective symmetrical fault current. Circuit breaker shall use no fusible devices in its operation. Current-limiting characteristic shall be in addition to normal time-delay and instantaneous-trip characteristics and other features as indicated.

l. Circuit Breakers With Solid-State Trip Devices: Provide indicated circuit breakers with solid-state trip devices having following features:

1. Ambient Compensation: Trip device insensitive to temperature changes between minus 20°C and plus 55°C.

2. Adjustability: Breaker ratings and trip settings shall be changeable by operation of controls on front panel of breaker, by change of plug-in element without removing breaker from mounting, or by combination of 2 methods.

3. Ground-Fault Tripping: Adjustable for pick-up and time-delay values. Provide for indicated units.

4. Provide clear plastic shield limiting access to rating plug and adjustments on solid state trip circuit breaker. Seal by attaching sealing wire through hole in posts provided. With wire seal installed, circuit breaker rating plug and adjustments shall not be "readily accessible."

2.6 INSULATED-CASE CIRCUIT BREAKERS

a. Manufacturers:

1. Square D Co.

2. General Electric

3. Or equal.

b. UL 489 and NEMA AB 1.

c. Ratings: Continuous-current, interrupting, and short-time-current ratings, and voltage and frequency ratings as indicated.

d. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with following features:

1. Moving Contacts Closing Speed: Independent of both control and operator.

e. Circuit-Breaker Trip Devices: Solid-state overcurrent trip device system that includes 1 integrally mounted current transformer or sensor per phase, release mechanism, and following features:

1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, which are independent of each other in both action and adjustment.

2. Temperature compensation to assure accuracy and calibration stability from minus 20°C to plus 55°C.

3. Field-adjustable, time-current characteristics.

4. Current Adjustability: Effected by operating controls on front panel or by changing plug-in elements or current transformers or sensors.

5. Three bands for long-time- and short-time-delay functions marked "minimum," "intermediate," and "maximum."

6. Five pickup points, minimum, for long-time- and short-time-trip functions.

7. Six pickup points, minimum, for instantaneous-trip functions.

8. Ground fault protection with at least 3 short-time-delay settings and 37 trip-time-delay bands. Adjustable current pickup.

9. Trip Indication: Labeled lights or mechanical indicators on trip device shall indicate type of fault causing breaker trip. If lights are used, integral power source shall maintain indication for 60 hrs, minimum.

f. Auxiliary Contacts for Remote Indication: Where remote indication of breaker position is indicated, provide spare auxiliary switch in addition to other auxiliary switches required for normal breaker operation. Spare auxiliary switch shall consist of 2 Type "a" and 2 Type "b" stages (contacts), wired to terminal block in breaker housing.

g. Draw out Features: Circuit-breaker mounting assembly equipped with racking mechanism that properly positions power circuit breaker and holds it rigidly in connected, test, and fully disconnected positions and includes following features:

1. Interlock arrangement, preventing movement of circuit breaker to or from connected position when it is in closed position and closure of circuit breaker unless it is in connected, test, or disconnected position.

2. Construction, permitting racking open circuit breaker to or from connected, test, and disconnected positions with associated compartment door closed or equivalent dead-front barrier protection, and manual withdrawal to position for removal from structure with door open.

3. Primary disconnecting devices disengaged and secondary disconnecting devices engaged when breaker is in test position.

4. Primary and secondary devices disengaged when circuit breaker is in disconnected position.

5. Ground contact engaged when circuit-breaker element is in connected and test positions.

h. Circuit-Breaker Features and Accessories: Include following:

1. Padlocking Provisions: For installing at least 2 padlocks on each breaker to secure its enclosure and prevent movement of draw out mechanism.

2. Operating Handle: Provide 1 for each manually operated breaker. No handle ties are permitted.

3. Electric Close Button: Provide 1 for each electrically operated breaker.

4. Indicating Lights: Contacts for "Breaker Open" and "Breaker Closed," for main and bus tie circuit breakers, and for other indicated breakers.

2.7 OCPD ACCESSORIES

a. Key Interlocks: Arrange interlocking so keys are held captive at devices indicated. Where future key interlocking provisions are indicated, provide necessary mountings and hardware as required for future installation.

b. Instantaneous Undervoltage Trip Device: For indicated OCPDs.

c. Adjustable-Time-Delay Undervoltage Trip Devices: For indicated OCPDs.

d. Shunt-Trip Devices for Circuit Breakers: Where indicated, arrange to trip breaker from external source of power through control switch or relay contacts.

2.8 SPARE FUSE CABINET (Where Indicated)

a. Cabinet: Wall-mounted, 18 gauge minimum steel unit with full-length, recessed piano-hinged door with key coded cam lock and pull.

b. Size: Provide for orderly storage of all spare fuses of this project plus 15 percent spare capacity, minimum.

c. Finish: Gray baked enamel.

d. Cabinet Door: Bear legend in stencilled 1-1/2-inch high letters, "Spare Fuses."

3.0 EXECUTION

3.1 INSTALLATION

a. Fuses:

1. Install fuses in fusible devices indicated.

b. Independently Mounted OCPDs:

1. Locate as indicated and install in accordance with manufacturer's written installation instructions.

c. Factory install OCPDs furnished in distribution equipment.

3.2 APPLICATION OF FUSES

a. Control Circuits: Class CC, time delay.

b. General Purpose Fusible Switches: Apply following class and types:

1. 30-600 Amperes: Class J or RK1, time delay.

2. 601-6,000 Amperes: Class L, time delay.

(a) Size at 125% of motor FLA not to exceed 150%.
(b) For transformers, size 12 times FLA for .1 second and 25 times for 0.1 second.
(c) Size at 100% of load for mains and feeders with non-inductive loads.

c. Combination Starters: Class J or RK1, time delay.

d. Bolted Pressure Switches: Class L, time delay.

3.3 IDENTIFICATION

a. Identify with components as specified in Section 16195.

3.4 CONTROL WIRING INSTALLATION

a. Install wiring between OCPDs and control/indication devices as specified in Section 16120 for hard wired connections.

3.5 CONNECTIONS

a. Check connectors, terminals, bus joints, and mountings for tightness.

b. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.6 GROUNDING

a. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

b. Ground in accordance with Section 16452.

3.7 COORDINATION STUDY

a. Where coordination study recommends changes in types, classes, features or ratings of equipment or devices those indicated, make written request for instructions. Obtain instructions from Engineer before ordering equipment or devices recommended to be changed.

3.8 FIELD QUALITY CONTROL

a. Manufacturer's Field Services:

1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum of 1/2 workday, travel time excluded, for assistance during plant construction, plant startup, equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of:

   (a) 1/2 manday for Instructional Services.

2. Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, and troubleshooting.

b. Testing:

1. Reports: Prepare certified written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made.

2. Labeling: Upon satisfactory completion of tests and related effort, apply label to tested components indicating test results, date, and responsible person.

3. Schedule visual and mechanical inspections and electrical tests with at least 1 week's advance notification.

4. Pretesting: Upon completing installation of system, perform following preparations for tests:

   (a) Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
   (b) Make continuity tests of circuits.
   (c) Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
   (d) Comply with manufacturer's instructions for installation and testing of OCPDs.

5. Visual and mechanical inspection: Include following inspections and related work.

   (a) Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective

device ratings and settings. Use accepted revised ratings or settings to make final system adjustments.

(b) Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

(c) Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.

(d) Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

(e) Clean OCPDs using manufacturer's approved methods and materials.

(f) Verify installation of proper fuse types and ratings in fusible OCPDs.

6. Electrical Tests: Include following items performed in accordance with manufacturer's instructions:

(a) Insulation resistance test of OCPD conducting parts. Insulation resistance less than 100 megohms is not acceptable.

(b) Verify trip unit reset characteristics for insulated-case circuit breakers.

(c) Make adjustments for final settings of adjustable-trip devices.

(d) Activate auxiliary protective devices such as ground fault or undervoltage relays, to verify operation of shunt-trip devices.

(e) Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.

(f) Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.

g) Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.

7. Retest: Correct deficiencies identified by tests and observations and retest. Verify by system tests that specified requirements are met.

3.9 CLEANING

a. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Service disconnects.
2. Feeder and equipment disconnects.
3. Enclosed circuit breakers.

1.2 SUBMITTALS

a. Submit the following for Engineer's approval.

b. Product Data:

1. Submit for switches, circuit breakers, and accessories.
2. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.

c. Shop Drawings:

1. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

d. Test Results:

1. Field test reports indicating and interpreting test results.

e. Operating and Maintenance Data:

1. Maintenance data for tripping devices.

1.3 QUALITY ASSURANCE

a. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

c. Single-Source Responsibility: Enclosed switches and circuit breakers shall be product of single manufacturer.

2.0 PRODUCTS

2.1 MANUFACTURERS

a. Fusible Switches:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

b. Fused Power Circuit Devices:

1. Square D Co.

2. Boltswitch.

c. Molded-Case Circuit Breakers:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

d. Combination Circuit Breaker and Ground Fault Trip:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

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e. Molded-Case Current-Limiting Circuit Breakers:

1. Square D Co.

2. Cutler-Hammer Products/Westinghouse Electric Co.

2.2 ENCLOSED SWITCHES

a. Enclosed Non-fusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks.

b. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

c. Enclosed Fusible Switch Larger Than 800 Amperes: Bolted-pressure or high-pressure contact switch, bus drilled to accommodate specified fuses, enclosure consistent with environment where located.

1. Minimum Fault Current Rating: 100,000 symmetrical rms amperes.

2.3 ENCLOSED CIRCUIT BREAKERS

a. Enclosed Molded-Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.

b. Characteristics:

1. Frame size, trip rating, number of poles, and auxiliary devices as indicated

2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amperes minimum

3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.

3.0 EXECUTION

3.1 INSTALLATION

a. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

b. Install enclosed switches and circuit breakers level and plumb.

c. Install wiring between enclosed switches and circuit breakers and control/indication devices.

d. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.2 FIELD QUALITY CONTROL

a. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation.

b. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.5 for enclosed switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

c. Training:

1. Train Owner's maintenance personnel on procedures and schedules for startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Review operating and maintenance data.

3.3 ADJUSTING

a. Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.4 CLEANING

a. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. ac motor control devices rated 600 v and below.

b. Overcurrent protective devices and disconnect switches used with motor controllers are specified in Section 16475.

1.2 DEFINITIONS

a. Motor Controller: Device that controls, protects, and energizes electric motor, and where required, controls its speed or torque or power delivered by it.

1.3 SUBMITTALS

a. Submit the following for Engineers approval.

1. Product Data:

   (a) Include dimensions, ratings, and data on features and components.

2. Test Results:

   (a) Certified reports of field tests and observations.

3. Miscellaneous:

   (a) Load Current and Overload Relay Heater List: Compiled by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.

4. Operation and Maintenance (O&M) Data:

   (a) Manufacturer's data on maintenance and operation of equipment.

1.4 QUALITY ASSURANCE

a. Single-Source Responsibility: Obtain similar motor-control devices from single manufacturer.

b. Manufacturer Qualifications:

1. Provide controllers from manufacturers regularly engaged in manufacture of equipment of types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 yrs.

c. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

d. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) No. 70.

1.5 COORDINATION

a. Coordinate features of controllers and control devices with pilot devices and control circuits provided under other sections of Specifications covering control systems.

1.6 MAINTENANCE

a. Extra Materials:

1. Spare Fuses and Incandescent Indicating Lamps: Furnish one spare for every 5 installed units, but not less than one set of 3 of each kind.

2.0 PRODUCTS

2.1 MANUFACTURERS

a. Manual and Magnetic Motor Controllers:

1. Square D Company.

2. Westinghouse Electric Corporation.

3. Eaton Corporation.

4. Furnas Electric Controls.

5. or, approved equal.

2.2 MOTOR CONTROLLERS, GENERAL

a. Coordinate features of each motor controller with ratings and characteristics of supply circuit, motor, required control sequence, duty cycle of motor, drive, and load, and pilot device, and control circuit affecting controller functions. Provide controllers horsepower rated to suit motor controlled.

b. NEMA Size 1 minimum.

c. Contacts shall open each ungrounded connection to motor.

d. Overload Relays:

1. Ambient-compensated type with inverse-time-current characteristic.

2. Provide with heaters or sensors in each phase matched to nameplate full load current of specific motor to which connected with appropriate adjustment for duty cycle.
3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated. Select to protect motor against voltage unbalance and single phasing.

e. Enclosures:

1. For individually mounted motor controllers and control devices, comply with NEMA 250.

2. Provide enclosures suitable for environmental conditions at controller location.

3. Provide NEMA Type enclosures as indicated or required to suit environment where located.

2.3 MANUAL MOTOR CONTROLLERS

a. Quick-make, quick-break toggle action.

b. Doublebreak silver alloy contacts.

c. Pilot light.

d. Padlocking provision.

2.4 MAGNETIC MOTOR CONTROLLERS

a. Full voltage, nonreversing, across-the-line, magnetic controller, except where another type indicated.

b. Control Circuit: 120 v. Control power transformer integral with controller where no other supply of 120 v control power to controller indicated. Control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100% spare capacity.

c. Combination Controller: Switch type; fused or nonfused as indicated; quick-make, quick-break switch; factory assembled with controller and arranged to disconnect it. For fused switches, provide rejection type fuse clips and fuses rated as indicated.

d. Combination Controller: Motor circuit protector; molded case circuit breaker type with magnetic only trip element calibrated to coordinate with actual locked rotor current of connected motor and controller overload relays. Provide breakers factory-assembled with controller, interlocked with unit cover or door, and arranged to disconnect controller. Provide motor circuit protectors with field-adjustable trip elements.

e. Overvoltage/Undervoltage/Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

1. Provide in starter enclosure for Size 2 and larger starters.

2. Delay initial motor start.

3. Delay motor restart due to starter dropout caused by undervoltage or starter coil circuit interruption for maintained control circuits.

4. Adjustable on delay from 0.15 to 30.0 sec set at 10.0 sec.

5. Connect control relay in motor starter coil circuit.

6. Coordinate control relay selection with motor starter to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

2.5 AUXILIARY CONTROL DEVICES

a. General: Furnish auxiliary control device as shown on 1-line diagrams, Drawings, or as specified. Factory-install in controller enclosure except as otherwise indicated.

b. Pushbutton Stations, Pilot Lights, and Selector Switches: Heavy duty type.

c. Stop Pushbutton Station: Momentary break pushbutton station with factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.

d. Lockout Pushbutton Station: Maintained contact red mushroom pushbutton station with factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.

e. Control Relays: Auxiliary and adjustable time-delay relays.

f. Elapsed Time Meters: Heavy duty with digital readout in hrs.

g. Ammeters, Voltmeters, and Frequency Meters: Panel type, 2 ½-in. minimum size with 90 or 120 degree scale, and ±2% accuracy. Where indicated, provide transfer device with off position.

h. Current Sensors: Rated to suit application.

i. Current-Sensing Phase-Failure Relays: Solid-state sensing circuit with isolated contacts for hard-wired connection. Arranged to operate on phase failure, phase reversal, current unbalance of from 5% to 30%, or loss of supply voltage. Provide adjustable response delay.

3.0 EXECUTION

3.1 INSTALLATION

a. General: Install motor controllers and auxiliary motor control devices in accordance with manufacturer's written instructions and approved submittals.

b. Mounting:

1. For control equipment at walls, bolt single units to wall. Mount multiple units on light-weight structural steel channels bolted to wall.

2. For controllers not at walls, provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of

3/8 in. thick steel plates, 6 in. square, bolted to floor. Use feet for welded attachment of 1-1/2-in. by 1-1/2-in. by 1/4 in. vertical angle posts not over 3 ft oc. Connect posts with horizontal lightweight slotted steel channels and bolt control equipment to channels.

3. Unless shown otherwise on plans.

c. Motor Controller Fuses and Circuit Breakers: Conform to requirements of Section 16475.

3.2 IDENTIFICATION

a. Comply with Section 16195.

3.3 CONTROL WIRING INSTALLATION

a. Install wiring as specified in Section 16120.

b. Install wiring in enclosures bundled, trained, and supported.

3.4 CONNECTIONS

a. Tighten connectors, terminals, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements not indicated, comply with tightening torques specified in UL 486A and 486B.

3.5 FIELD QUALITY CONTROL

a. Manufacturer's Field Services:

1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum mandays indicated, travel time excluded, for equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of:

(a) ½ manday for Instructional Services.

b. Testing:

1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

2. On completing installation of system, perform following tests.

(a) Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by manufacturer.
(b) Make continuity tests of circuits.
(c) Review updating of final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
(d) Review manufacturer's written instructions for installation and testing of motor control devices.

3. Visual and Mechanical Inspection: Include following inspections and related work.

(a) Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments.
(b) Inspect for defects and physical damage and nameplate compliance with Drawings.
(c) Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions.
(d) Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.
(e) Clean devices using manufacturer's approved methods and materials.
(f) Verify proper fuse types and ratings in fusible devices.

4. Electrical Tests: Perform following in accordance with manufacturer's written instructions.

(a) Insulation resistance test of motor control devices conducting parts to extent permitted by manufacturer's written instructions. Insulation resistance less than 100 megohms not acceptable.
(b) Use primary current injection to check performance characteristics of motor circuit protectors and for overload relays of controllers for motors 15 hp and larger. Trip characteristics not within manufacturer's published time-current tolerances not acceptable.
(c) Make adjustments for final settings of adjustable trip devices.
(d) Test auxiliary protective features such as loss of phase, phase unbalance, and undervoltage to verify operation.
(e) Check for improper voltages at terminals in controllers having external control wiring when controller disconnect opened. Voltage over 30 v unacceptable.

5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met.

3.6 ADJUSTING

a. Overvoltage/Undervoltage/Phase Failure Control Relay:

1. Adjust control relay to cause motor starter to drop out at voltage slightly higher than dropout voltage of starter and have dropout time slightly faster than motor starter to ensure if motor starter drops out, relay will drop out.

3.7 CLEANING

a. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using manufacturer's recommended methods and materials.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Exterior lighting fixtures, lamps, ballasts, poles standards, and accessories.

1.2 REFERENCES

a. American Association of State Highway and Transportation AASHTO LTS-1-Standard Officials (AASHTO). Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

b. American National Standards Institute (ANSI):

1. ANSI C2-90 - National Electrical Safety Code.

2. ANSI C78.1-91 to C78.1502 - Electric Lamps.

3. ANSI C82.2-84 - Fluorescent Lamp Ballast - Method of Measurement.

4. ANSI C82.4-85 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

5. ANSI C136.13-87 - Roadway Lighting - Metal Brackets for Wood Poles.

6. ANSI C136.30 - Roadway Lighting Equipment - Fiber-Reinforced Plastic (FRP) Lighting Poles.

7. ANSI 05.1-92 - Wood Poles - Specifications and Dimensions.

c. American Society for Testing and Materials (ASTM):

1. ASTM A500 - REV A-90 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

2. ASTM B209-90 - Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate.

3. ASTM B429-92 - Standard Specifications for Aluminum-Alloy Extruded Structural Pipe and Tube.

d. American Wood Preservers Association (AWPA): AWPA C4 - Poles, Preservative Treatment, Pressure Processed.

e. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE C62.41-91-IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

f. Underwriter's Laboratories (UL):

1. UL 773-87 - UL Standard for Safety Plug-In, Locking Type Photocontrols for Use with Area Lighting.

2. UL 844-90 - UL Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.

3. UL 935-84 - UL Standard for Safety Fluorescent Lamp Ballasts

4. UL 1029-86 - UL Standard for Safety High-Intensity Discharge Lamp Ballasts.

5. UL 1570-88 - UL Standard for Safety Fluorescent Lighting Fixtures.

6. UL 1571-91 - UL Standard for Safety Incandescent Lighting Fixtures.

7. UL 1572-91 - UL Standard for Safety High Intensity Discharge Lighting Fixtures.

1.3 DEFINITIONS

a. Fixture: Complete lighting unit. Fixtures include lamp or lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply.

b. Lighting Unit: Fixture, or assembly of fixtures with common support, including pole or bracket plus mounting and support accessories.

c. Luminaire: Fixture.

1.4 SUBMITTALS

a. Submit the following for Engineer's approval.

b. Product Data.

1. Describe fixtures, lamps, ballasts, poles, and accessories.

2. Arrange Product Data in order of fixture designation.

3. Include data on features, poles, accessories, and following:

   (a) Outline drawings of fixtures and poles indicating dimensions and principal features.
   (b) Electrical ratings and photometric data with certified results of independent laboratory tests.

c. Shop Drawings:

1. Detail fixtures and poles and indicating dimensions, weights, methods at field assembly, components, and accessories.

d. Test Results:

1. Certified reports of field tests and observations.

1.5 QUALITY ASSURANCE

a. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "Labeled" shall be as defined in National Electrical Code, Article 100.

b. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.
2. Comply with ANSI C2, "National Electrical Safety Code."

c. Fixtures for Hazardous Locations: Conform to UL 844 or get Factory Mutual Engineering and Research Corporation (FM) certification for the class and division of hazard.

d. Manufacturers' Qualifications: Firms experienced in manufacturing lighting units that are similar to those indicated for this Project and that have record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

a. Poles:

1. General: Store poles on decay-resistant treated skids at least 1 ft above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.

2. Metal Poles: Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 WARRANTY

a. Special Project Warranty: Submit warranty, mutually executed by manufacturer and the Installer, agreeing to replace external parts of lighting fixtures exhibiting failure of finish as specified below. This warranty is in addition to, and not limitation of, other rights and remedies Owner may have under Contract Documents.

1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.

2. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation.

3. Special Project Warranty Period: 5 yrs, beginning on the date of Substantial Completion.

1.8 MAINTENANCE

a. Extra Materials

1. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to Owner.

   (a) Lamps: 10 lamps for each 100 of each type and rating installed. Furnish at least 1 of each type.
   (b) Glass and Plastic Lenses, Covers, and Other Optical Parts: 1 for each 100 of each type and rating installed. Furnish at least 1 of each type.
   (c) Ballasts: 1 for each 100 of each type and rating installed. Furnish at least 1 of each type.
   (d) Globes and Guards: 1 for each 20 of each type and rating installed. Furnish at

least 1 of each type.

2.0 PRODUCTS

2.1 FIXTURE COMPONENTS, GENERAL

a. Metal Parts: Free from burrs and sharp edges and corners.

b. Sheet Metal Components: Corrosion-resistant aluminum, except as indicated. Form and support to prevent warping and sagging.

c. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed fixtures.

d. Doors, Frames, and Other Internal Access Provisions: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect ballast.

e. Exposed Hardware Material: Stainless steel.

f. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:

1. White Surfaces: 85%.

2. Specular Surfaces: 83%.

3. Diffusing Specular Surfaces: 75%.

g. Plastic Parts: Resistant to yellowing and other changes due to aging and exposure to heat and UV radiation.

h. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.

i. Photoelectric Relay: UL 773.

1. Contact Relays: Single-throw, arranged to fail in the "on" position and factory set to turn light unit on at 1.5 to 3 footcandles and off at 4.5 to 10 footcandles with 15 sec' minimum time delay.

2. Relay Mounting: In fixture housing.

2.2 FLUORESCENT FIXTURES

a. Fixtures: Conform to UL 1570.

b. Ballasts: Conform to UL 935, certified by Electrical Testing Laboratory (ETL). Labeled by Certified Ballast Manufacturers Association (CBM).

1. Type: High-power factor type rated for -20°C starting and listed for use in outdoor fixtures.

2. Sound Rating: A or B.

3. Voltage: Match connected circuits.

4. Ballasts to have fused protection.

2.3 HIGH-INTENSITY DISCHARGE (HID) FIXTURES

a. Fixtures: Conform to UL 1572.

b. Ballasts: Conform to UL 1029 and ANSI C82.4, provide constant wattage autotransformer (CWA) or regulating high-power factor type, unless otherwise indicated.

1. Operating voltage matches system voltage.

2. Single-Lamp Ballasts: Minimum starting temperature of -30°C.

3. Construct ballasts so open circuit operation will not reduce average life.

4. Ballasts to have fused protection.

c. Instant Restrike Device: Solid-state potted module, mounted inside fixture and compatible with mogul-based HPS lamps, ballasts, and sockets up to 150 watts.

1. Restrike ranges: 105 to 130 vac.

2. Output voltage does not exceed 250 v peak or 150 vac RMS.

2.4 INCANDESCENT LIGHTING FIXTURES

a. Conform to UL 1571.

2.5 FIXTURE SUPPORT COMPONENTS

a. Pole-Mounted Fixtures: Conform to AASHTO LTS-1.

b. Wind-Load Strength: 100 mph and 1.3 gust factor for total support assembly, including pole, base, and anchorage, where used, to carry fixtures, supports, and appurtenances at indicated heights above grade without deflection or whipping.

c. Arm, Bracket, and Tenon Mount Materials: Match the poles.

d. Mountings, Fastenings, and Appurtenances: Corrosion-resistant components compatible with poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position luminaire to provide indicated light distribution.

e. Pole Shafts: As shown on Plans.

f. Pole Bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts, and bolt covers.

g. Steel Poles: Steel tubing conforming to ASTM A500, Grade B, carbon steel with minimum yield of 46,000 psi. Poles are 1-piece construction up to 40 ft in length and have access handhole in wall.

h. Steel Mast Arms: Fabricated from 2-in. pipe, continuously welded to pole attachment plate and having span and rise as indicated.

i. Metal Pole Brackets: Designed to match pole metal. Provide cantilever brackets without underbrace, in the sizes and styles indicated, with straight tubular end section to accommodate the fixture.

j. Pole-Top Tenons: Fabricated to support fixture indicated and securely fastened to the pole top.

k. Metal Pole Grounding Provisions: Welded 1/2-in. threaded lug, accessible through handhole.

2.6 LAMPS

a. Conform to ANSI Standards, C78 series, applicable to each type of lamp. Provide fixtures with indicated lamps. Where lamps are not indicated, provide lamps recommended by manufacturer.

2.7 FINISH

a. Metal Parts: Manufacturer's standard finish except as otherwise indicated. Finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove poles, fixtures, and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.
b. Other Parts: Manufacturer's standard finish except as otherwise indicated.

3.0 EXECUTION

3.1 INSTALLATION

a. Set units plumb, square, level, and secure according to manufacturer's written instructions and approved submittals.

3.2 CONCRETE FOUNDATIONS

a. Construct concrete foundations with 3,000-lb, 28-day concrete.

b. Embedded Poles: Set poles to indicated depth, but not less than 1/6 of pole length below finish grade. Dig holes large enough to permit use of tampers full depth of hole. Backfill in 6-in. layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

c. Pole Installation: Use fabric web slings (not chain or cable) to raise and set poles.

d. Fixture Attachment: Fasten to indicated structural supports.

e. Fixture Attachment with Adjustable Features or Aiming: Attach fixtures and supports to allow aiming for indicated light distribution.

f. Lamp fixtures with indicated lamps according to manufacturer's instructions. Replace malfunctioning lamps.

3.3 GROUNDING

a. Ground fixtures and metal poles as specified in Section 16452.

1. Poles: Install 10-ft driven ground rod at each pole.

2. Nonmetallic Poles: Ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor.

3.4 FIELD QUALITY CONTROL

a. Inspect installed units for damage.

b. Provide advance notice of dates and times for field tests.

c. Provide instruments to make and record test results.

d. Tests: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source. Include the following:

1. Photometric Tests: Measure light intensities at locations where specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.

2. Check for excessively noisy ballasts.

3. Check for uniformity of illuminations.

4. Written report of tests indicating actual illumination results.

e. Replace or repair damaged and malfunctioning units and retest.

3.5 ADJUSTING AND CLEANING

a. Clean components on completion of installation. Use methods and materials recommended by manufacturer.

b. Adjust aimable fixtures to provide required light intensities.

- - o 0 o - -

APPENDIX G

APPROVED PRODUCTS LIST

APPROVED WATER AND SEWER PRODUCTS LIST

All Products must conform to ANSI/NSF standards 60 or 61, if available.

1. Fire Hydrants (Flushing Valves, AWWA C 502) (Fire Hydrant shall be installed with 5" STORZ™ Quick Connect Steamer Nozzle and Pumper 2.5" N.S.T., Nozzle should be pressed onto hydrant at factory, not placed as an adapter in the field)
    A. Mueller – Model: Super Centurion 250
    B. American Darling – Model: B84B

2. Gate Valves (3/4 inch thru 2 inch, AWWA Approved, Bronze)
    A. Hammond
    B. Watts
    C. Red and White
    D. Matco Norca
    E. Eagle
    F. C and F

3. Gate Valves (3 inch and larger, AWWA C 509, Resilient Wedge Type, Open Left)
    A. Mueller
    B. Waterous
    C. American Darling
    D. Kennedy
    E. M & H
    F. US Valve
    G. Clow

4. PVC Pipe (AWWA C 900, C 905, C 909)
    A. J-M Manufacturing
    B. Certain Teed Corp.
    C. Diamond Plastics Corp.
    D. Carlon Company

5. Mechanical Joint Restraints
    A. Smith Blair Cam Lock
    B. EBAA Iron Inc.
    C. Megalug
    D. Star Pipe Products

6. Ductile Iron Fittings For C 900, C 905 Pipe (AWWA C 110, AWWA C 153)
    A. All manufacturers compliant with AWWA and/or ASTM standards.

7. Steel Pipe (AWWA C 200)
    A. All manufacturers compliant with AWWA and/or ASTM standards.

8. Steel Pipe Coatings, Exterior (AWWA C 203)
    A. All manufacturers compliant with AWWA and/or ASTM standards.

9. Steel Pipe Coatings, Interior (AWWA C 210, D 102, TNRCC NSF 61)
    A. All manufacturers compliant with AWWA and/or ASTM standards.

10. Curb Stop – Bronze, Ball Valve, 360° Rotation, Locking Wing

    A. Ford
    B. Mueller – Model: Mark II Oriseal

11. Corporation Stop – Bronze
    A. Ford – Model: F100 1" CC Tapered Thread
    B. Mueller – Model: H-15008 or H-15013 1" CC Tapered Thread

12. Service Saddle – Single or Dual Strap, Stainless Steel, Bronze
    A. Ford S-90 for PVC 1" CC Tapered Thread
    B. Ford Single or Dual Strap for AC Pipe 1" CC Tapered Thread

13. U Branch
    A. Mueller ¾" Full Port Ball Valves

14. Water Meter
    A. Neptune Trident or T10(Schlumberger)

15. Service Tubing (3/4 inch thru 2 inch Polyethylene SDR 9, AWWA C-901)
    A. NuMex
    B. Envot
    C. Vrisco Pipe
    D. ADS

16. Polyethylene Encasement Tubing for Ductile Iron Systems (AWWA C 105)
    A. All manufacturers compliant with AWWA and/or ASTM standards.

17. Air Release Valve, 2 inch (Bonney Forge 3,000# Threadolet)
    A. APCO – No. 200
    B. GA Industries – Fig. 2- AR
    C. Val-matic, 2 inch

18. Meter Boxes
    A. Concrete
        a. Brooks Products
        b. Southern Precast

19. SCADA
    A. Zetron – RTU Model 1700 MTU Compatible

20. Coatings (Manholes & Lift Stations) (80 mil required for new construction; 125 mil required for rehabilitation jobs)
    A. Strong Seal MS – 2
    B. Structural Rehab Products, L.P.
        a. SRP TC
        b. SRP ML-1

C. Thane Coat FE 100
D. Raven 405
E. Spectra Shield Liner
F. Poly-Triplex Liner System
G. Alternative to coating: Antimicrobial additive, ConShield® or approved equal, used to render the concrete uninhabitable for bacteria growth. The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be included in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture. The antibacterial additive shall have successfully demonstrated prevention of microbiologically induced corrosion in sanitary sewers for ten or more years. The antibacterial agent shall be used by factory certified precast concrete plants, and treated products shall be color marked by having colorant added at the precast plant to manufacturer standards to achieve adequate tint.

21. Tapping Sleeves – All Stainless
    A. JCM 432 or approved equal to be ANSI/NSF Standard 61 Certified

22. Sign Post
    A. Green U-Channel 12 Ft.
    B. Vandal-Proof Mounting Brackets

23. PVC Pipe (Sewer)
    A. SDR 26 ASTMD 3034

24. Lift Station Control Panels
    A. E. G. Controls
    B. Consolidated Electric
    C. Murphymatic
    D. Sta-Con, Inc.
    E. Automatic Control Systems
    F. Mercer Controls Division
    G. Motor Controls, Inc.

25. Lift Station Pumps
    A. Flygt

26. Grinder Pumps
    A. Hydromatic
    B. Myers
    C. Crane

27. Lift Station Odor Control
    A. REX-BAC-T Technologies (6" Poly-Air Activated Carbon Vent Filter)

APPROVED STORM SEWER PRODUCTS LIST

1. Manhole Covers and Rings (ASTM A 48, AASHTO H-20 Load Rating)
    A. Vulcan Foundry – 32 Inch diameter; Model V-2420
    B. Neenah Foundry – 32 Inch diameter; Model R-1741-F
    C. East Jordan Iron Works – 32 Inch diameter; Model V-1420
    D. Star Pipe Products – 32 Inch diameter

2. Storm Inlet Grates and Frames (ASTM A 48, AASHTO H-20 Load Rating)
    A. Vulcan Foundry
    B. Neenah Foundry
    C. East Jordan Iron Works, Inc.

3. Pipe Materials
    A. RCP, 24 inch and larger at all depths – ASTM 76 with rubber gasketed joints conforming to ASTM 433 (Various Manufacturers)
    B. HDPE, 24 inch and larger at all depths (Outside City of Seabrook Public Right-of-Way Only) – AASHTO CM-294 (Various Manufacturers)

4. Reinforced Concrete Box Culverts (ASTM C 789, C 850, AASHTO M259, M273 – Various Manufacturers)
    A. RCB, 24 inches x 24 inches and larger having minimum 2 feet to maximum 12 feet of cover – ASTM C789/AASHTO M259 joined with "Ramnek" joint sealing compound by K.T. Snyder Co.
    B. RCB, 24 inches x 24 inches and larger having less than 2 feet of cover or greater than 12 feet of cover – ASTM C850/AASHTO M276 joined with "Ramnek" joint sealing compound by K.T. Snyder Co.

5. Manholes and Storm Inlets (Precast Concrete)
    A. More-Tex
    B. Southern Precast
    C. Calvert
    D. Gifford Hill
    E. Brooks Products
    F. Dalworth
    G. Precast Systems, Inc.
    H. Koastal Precast, Inc.

6. Geotextile Fabric Wrap
    A. Trevira S1114

7. Pipe Casing Spacers & End Seals for Bored Crossings
    A. Pipeline Seal and Insulator (PSI)

8. Stormceptors
    A. Park

9. Pop-up PVC Yard Drains
    A. 4" PVC Drain, Model # NDS 422G

APPROVED STREET PRODUCTS LIST

1. Raised Pavement Markers (Class A, B, C, & D)
    A. Apex Universal

2. Type Y and Type W Traffic Buttons (Ceramic Only)
    A. Apex Universal

3. Raised Pavement Marker Adhesive
    A. Bundy Raised Pavement Marker Adhesive
    B. TxDOT Approved Epoxy

4. Thermoplastic Pavement Markings (125 mil thick)
    A. Flint Trading Inc. – Premark LKF Roadmarking Material

5. Prefabricated Pavement Markings (125 mil thick)
    A. Flint Trading Inc. – Premark LKF Roadmarking Material

6. Thermoplastic Adhesive
    A. Ashland Chemicals – Pliobond 10

7. Crack and Joint Sealant
    A. Elastometric-Type, Hot pour joint sealant conforming to TxDOT Item 433 and TxDOT Departmental Material Specification D-9-6310

8. Paints (Various Manufacturers)
    A. Only water based conforming to TxDOT specifications are approved for use in the City of Seabrook

9. Road Marker Posts
    A. Carsonite #CRM-375

10. Replaceable Delineator Post w/ Base (Epoxy or 8" Bundy Adhesive)
    A. Repo TM Model

11. Concrete Curing Membranes (Various Manufacturers)
    A. Liquid membrane-forming curing compound conforming to TxDOT Item 526 and TxDOT Departmental Material Specification D-9-8120

12. Chemical Stain for Use on Ramps for Handicapped Access (Cola Color, ADA Texas Accessibility Standards)
    A. Kemiko Concrete Products

13. Traffic Control Signalization, Lighting and Appurtenances
    A. All materials and manufactured products pertaining to traffic control signals, lighting, and associated appurtenances shall conform to current TxDOT specifications and shall be listed in the TxDOT Prequalified Master List of Approved Products at time of installation.

Texas Department of Insurance
333 Guadalupe St. P.O. Box 149104 Austin, TX 78714-9104

LIBERTY MUTUAL INSURANCE COMPANY

Skip over these navigation links.

Show Explanation of Terms

Table of Contents
General Info | Contact Info | Types of Insurance | Use of Credit | Attorney for Service | Ratings | Financial Info | Premiums | Complaint Ratios | Company History | Company Officers

General Information:

Return to top.

Type of Entity:	Fire and Casualty (FC)
Status of TX License:	Active
Company Status:	Normal Operations
License Number:	47950
NAIC Number:	23043
TDI Company Number:	47950
FEIN:	041543470
Home City/State:	MA
Origin:	Foreign
Date Incorporated/Organized:	01/01/1912
Date Licensed/Eligible/Registered in Texas:	01/01/1924
Date Cancelled/Ineligible/Inactive:	

Contact Information:

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Mailing Address:	175 Berkeley St Boston MA 02116-5066
Office Number:	(617)357-9500
Toll Free Number:	(800)344-0197
Fax Number:	(617)574-6688

Types of Insurance Licensed to Write:

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- Accident
- Aircraft Liability
- Aircraft Physical Damage

- Allied Coverages
- Auto Physical Damage
- Automobile Liability
- Boiler & Machinery
- Burglary & Theft
- Credit
- Fidelity & Surety
- Fire
- Forgery
- Glass
- Hail
- Health
- Inland Marine
- Liability Other than Auto
- Livestock
- Ocean Marine
- Rain
- Workers Comp and Emp Liability

Use of Credit:

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To determine if a company uses credit information for private passenger automobile or homeowners insurance.

Click Here for Use of Credit

Attorney for Service:

Return to top.

Click Here for Attorney for Service Guidelines

Corporation Service Company
211 East 7th Street Suite 620
Austin TX 78701 -3218

Rating By Financial Organization:

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The following organizations rate insurance companies on their financial strength and stability. Some of these companies charge for their services.

A.M. Best
Weiss Ratings Inc.
Standard & Poor's
Moody's Investors Service
Fitch IBCA, Duff and Phelps Ratings

Financial Information:

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As of:	Dec. 31, 2014	Dec. 31, 2015	Dec. 31, 2016
Total Assets	$42,655,158,668	$42,343,216,506	$44,001,881,687
Total Liabilities	$26,085,858,680	$26,527,948,893	$27,473,676,194
Asset to Liability Ratio	1.64	1.60	1.60
Capital	$10,000,000	$10,000,000	$10,000,000
Net Surplus	$16,559,299,988	$15,805,267,613	$16,518,205,493
Total Life Ins	N/A	N/A	N/A

Premiums:

Return to top.

As of:	Dec. 31, 2014	Dec. 31, 2015	Dec. 31, 2016
Life and Annuities	N/A	N/A	N/A
Accident and Health	$0	$0	$0
Property and Casualty	$232,143,676	$172,423,455	$109,769,155
Total Texas Premium	$232,143,676	$172,423,455	$109,769,155
National Premium	$4,332,533,880	$3,410,722,989	$2,158,127,459

Complaint Information:

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When considering the company's complaint index and ratio, be sure to review the company history information displayed below for recent acquisitions, mergers, or other events that may affect the figures displayed for this company.

	Dec 31, 2015		Dec 31, 2016		Oct 6, 2017
Confirmed Complaints:					
Life and Annuity	0		0		0
Accident and Health	0		0		0
Homeowner	0		0		0
Automobile	0		1		0
Workers' Compensation	0		0		0
Complaint Ratio/Index	Ratio	Index	Ratio	Index	
Life and Annuities	N/A	N/A	N/A	N/A	N/A
Accident and Health	N/A	N/A	N/A	N/A	N/A
Homeowner	N/A	N/A	.0000	.0000	N/A
Automobile	.0000	.0000	1.0989	113.1657	N/A
Workers' Compensation	.0000	.0000	.0000	.0000	N/A

Confirmed Complaints: the number of confirmed complaints closed against the company for the line of insurance and year indicated. A complaint is confirmed if the department receives information indicating that a company committed any violation of an applicable state insurance law or regulation, a federal requirement the department has authority to enforce or the term or condition of an insurance policy or

certificate. A complaint is also confirmed if the complaint and company's response, considered together, suggest that the company was in error or that the complainant had a valid reason for the complaint.

Complaint Ratios: the ratio, expressed as a percentage, is the number of closed confirmed complaints divided by the number of policies the company had in force for the line of insurance and year indicated.

Complaint Index: indicates how a company's ratio of the number of complaints to the number of policyholders compares to the average for all insurers. The index is calculated by dividing the company's percentage of complaints for a specific line of insurance by the company's percentage of the policies in force for the same line of insurance. The average index is 1.00. A number less than 1 indicates fewer complaints than average; a number greater than 1 indicates more complaints than average. For the most recent completed year, a given insurer's index may change over time, as policy count data is received by TDI. This will affect each insurer's percentage of the total.

Complaints against an insurance company are not part of the complaint tally above if the insurance company served only as a Third Party Administrator (TPA), a company hired simply to administer the paperwork of a health plan. Instead, they are included in the complaint record of the insurance company or HMO that hired the TPA. If a bonafide self-insured benefit plan hired the TPA, no complaint numbers are recorded as a part of the company/TPA's profile. Neither are profiles available for self-insured plans, as such plans are regulated under federal law.

Company History:

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Date	Event
09-12-2008	PENALTY OF $12,000 FOR FAILURE TO PAY INDEPENDENT REVIEW ORGANIZATION FEES IN A TIMELY BASIS IN TEXAS.
05-20-2005	PENALTY OF $50,000 FOR VIOLATIONS OF ADJUSTER LICENSING LAWS IN VERMONT.
11-26-2002	COMPANY AND BERKELEY MANAGEMENT CORPORATION, IRVING, TEXAS ACQUIRED GAINSCO COUNTY MUTUAL INSURANCE COMPANY (93956) FORT WORTH, TEXAS.
04-22-2002	CONVERTED FROM A MUTUAL PROPERTY AND CASUALTY INSURANCE COMPANY TO A STOCK PROPERTY AND CASUALTY INSURANCE COMPANY.
09-11-1997	PENALTY OF $15,000 PAID BY COMPANY AND LIBERTY MUTUAL FIRE INSURANCE COMPANY FOR VIOLATIONS FOUND DURING A MARKET CONDUCT EXAMINATION IN PENNSYLVANIA.
12-30-1996	PENALTY OF $5,900 FOR VILATIONS FOUND DURING A MARKET CONDUCT INVESTIGATION IN NEW YORK.
11-08-1996	PENALTY OF $19,000 PAID BY COMPANY AND LIBERTY MUTUAL FIRE INSURANCE COMPANY FOR VIOLATIONS FOUND DURING A MARKET CONDUCT EXAMINATION IN VIRGINIA.
07-07-1994	PENALTY OF $8,500 FOR VIOLATIONS WITH WORKERS' COMPENSATION POLICIES IN GEORGIA.
05-01-1989	PENALTY OF $637,500 PAID BY COMPANY AND LIBERTY MUTUAL FIRE INSURANCE COMPANY FOR UNDERWRITING PRACTICES AND RATING LAW VIOLATIONS IN NEW YORK.
03-13-1989	PENALTY OF $100,000 FOR VIOLATIONS WITH THE AUTOMOBILE MANUAL IN TEXAS.
01-01-1924	GRANDFATHERED FOR CAPITAL AND SURPLUS REQUIREMENTS

Company Officers:

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For names of the company's current officers, please contact the company at the phone number listed in the Contact Information above or on their website.

TEXAS SECRETARY of STATE
ROLANDO B. PABLOS

UCC | **Business Organizations** | **Trademarks** | **Notary** | **Account** | **Help/Fees** | **Briefcase** | Logout

BUSINESS ORGANIZATIONS INQUIRY - VIEW ENTITY

Filing Number:	121089400	**Entity Type:**	Domestic For-Profit Corporation
Original Date of Filing:	November 6, 1991	**Entity Status:**	In existence
Formation Date:	N/A		
Tax ID:	17426168542	**FEIN:**	
Duration:	Perpetual		

Name: R.P. CONSTRUCTORS, INC.
Address: 9455 IH 35 N
NEW BRAUNFELS, TX 78130 USA

REGISTERED AGENT | FILING HISTORY | NAMES | MANAGEMENT | ASSUMED NAMES | ASSOCIATED ENTITIES

Name	Address	Inactive Date
Robert Pfeiffer	72 LAZY LN San Marcos, TX 78666 USA	

Order | Return to Search

Instructions:
- To place an order for additional information about a filing press the 'Order' button.

TEXAS SECRETARY of STATE
ROLANDO B. PABLOS

UCC | **Business Organizations** | **Trademarks** | **Notary** | **Account** | **Help/Fees** | **Briefcase** | Logout

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Duration:	Perpetual		

Name: R.P. CONSTRUCTORS, INC.
Address: 9455 IH 35 N
NEW BRAUNFELS, TX 78130 USA

REGISTERED AGENT | FILING HISTORY | NAMES | MANAGEMENT | ASSUMED NAMES | ASSOCIATED ENTITIES

Last Update	Name	Title	Address
February 3, 2017	ROBERT PFEIFFER	PRESIDENT	9455 IH 35 NORTH NEW BRAUNFELS, TX 78130 USA
February 3, 2017	ROBERT PFEIFFER	DIRECTOR	9455 IH 35 NORTH NEW BRAUNFELS, TX 78130 USA
February 3, 2017	KRISTEN MCFERRIN	TREASURER	9455 IH 35 NORTH NEW BRAUNFELS, TX 78130 USA
February 3, 2017	DOHN WHITE	SECRETARY	9455 IH 35 NORTH NEW BRAUNFELS, TX 78130 USA

Order | Return to Search

Instructions:
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Filing Number: 121089400

05-102
(Rev.9-15/33)

Texas Franchise Tax Public Information Report

To be filed by Corporations, Limited Liability Companies (LLC), Limited Partnerships (LP), Professional Associations (PA) and Financial Institutions

Tcode 13196 Franchise

Taxpayer number: 1 7 4 2 6 1 6 8 5 4 2

Report year: 2 0 1 6

***You have certain rights** under Chapter 552 and 559, Government Code, to review, request and correct information we have on file about you. Contact us at 1-800-252-1381.*

Taxpayer name: R P CONSTRUCTORS, INC	◯ Blacken circle if the mailing address has changed.
Mailing address: 9455 IH 35 N	Secretary of State (SOS) file number or Comptroller file number: 0121089400
City: NEW BRAUNFELS · State: TX · ZIP code plus 4: 78130	

◯ Blacken circle if there are currently no changes from previous year; if no information is displayed, complete the applicable information in Sections A, B and C.

Principal office	9455 IH 35 N, NEW BRAUNFELS, TX, 78130 7132
Principal place of business	9455 IH 35 N, NEW BRAUNFELS, TX, 78130 7132

You must report officer, director, member, general partner and manager information as of the date you complete this report.

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Please sign below! **This report must be signed to satisfy franchise tax requirements.**

SECTION A Name, title and mailing address of each officer, director, member, general partner or manager.

Name	Title	Director	Term expiration (m m d d y y)
ROBERT PFEIFFER	PRESIDENT	● YES	
Mailing address: 9455 IH 35 NORTH	City: NEW BRAUNFELS	State: TX	ZIP Code: 78130
KRISTEN MCFERRIN	TREASURER	◯ YES	
Mailing address: 9455 IH 35 NORTH	City: NEW BRAUNFELS	State: TX	ZIP Code: 78130
DOHN WHITE	SECRETARY	◯ YES	
Mailing address: 9455 IH 35 NORTH	City: NEW BRAUNFELS	State: TX	ZIP Code: 78130

SECTION B Enter information for each corporation, LLC, LP, PA or financial institution, if any, in which this entity owns an interest of 10 percent or more.

Name of owned (subsidiary) corporation, LLC, LP, PA or financial institution	State of formation	Texas SOS file number, if any	Percentage of ownership
NONE			

SECTION C Enter information for each corporation , LLC, LP, PA or financial institution, if any, that owns an interest of 10 percent or more in this entity.

Name of owned (parent) corporation, LLC, LP, PA or financial institution	State of formation	Texas SOS file number, if any	Percentage of ownership
NONE			

Registered agent and registered office currently on file *(see instructions if you need to make changes)*

Agent: ROBERT PFEIFFER

You must make a filing with the Secretary of State to change registered agent, registered office or general partner information.

Office: 9455 IH 35 NORTH · City: NEW BRUANFELS · State: TX · ZIP Code: 78130

The information on this form is required by Section 171.203 of the Tax Code for each corporation, LLC, LP, PA or financial institution that files a Texas Franchise Tax Report. Use additional sheets for Sections A, B and C, if necessary. The information will be available for public inspection.

I declare that the information in this document and any attachments is true and correct to the best of my knowledge and belief, as of the date below, and that a copy of this report has been mailed to each person named in this report who is an officer, director, member, general partner or manager and who is not currently employed by this or a related corporation, LLC, LP, PA or financial institution.

sign here	Title	Date	Area code and phone number
	PRESIDENT	03/04/2016	(512) 392 - 5111

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