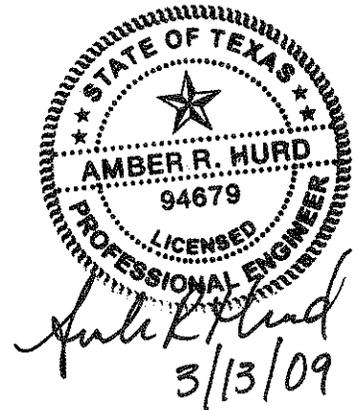


**CONTRACT DOCUMENTS
AND TECHNICAL SPECIFICATIONS FOR
THE CONSTRUCTION OF WATER SUPPLY AND
STORAGE FACILITY NO. 5**

CF PROJECT NO. 0512-015-00

March 2009



Construction Management ▪ Geographic Information Systems ▪ Hydraulics and Hydrology ▪ Land Development
Public Works ▪ Right-of-Way Acquisition ▪ Site Development ▪ Subsurface Utility Engineering
Surveying ▪ Telecommunications ▪ Transportation ▪ Utility Coordination and Design

Section 00003

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>No. of Pages</u>
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS		
00003	Table of Contents	1
00020	Notice to Bidders	1
00100	Instruction to Bidders	8
00300	Bid Form	4
00500	Agreement.....	5
00610	Performance Bond.....	2
00620	Payment Bond	2
00700	General Conditions	62
00800	Supplementary Conditions.....	5
DIVISION 1 - GENERAL REQUIREMENTS		
01010	Summary of Work.....	4
01270	Measurement and Payment	3
01330	Submittal Procedures	4
01340	Shop Drawings, Product Data, and Samples.....	3
01410	TPDES Requirements	13
01454	Testing Laboratory Services.....	3
01555	Traffic Control and Regulation	4
01570	Storm Water Pollution Control.....	13
01575	Stabilized Construction Exit	4
01576	Waste Material Disposal	2
DIVISION 2 – SITE WORK		
02260	Trench Safety System	3
02316	Excavation and Backfill for Structures	9
02317	Excavation and Backfill for Utilities	14
02319	Borrow	2
02321	Cement Stabilized Sand.....	8
02330	Embankment	4
02506	Polyvinyl Chloride Pipe.....	5
02511	Water Mains.....	16
02514	Disinfection of Water Lines.....	3
02515	Hydrostatic Testing of Pipelines.....	3
02520	Fire Hydrants.....	3
02532	Sanitary Sewer Force Mains	6
02754	Concrete Driveways.....	2
02911	Topsoil	2
02921	Hydromulch Seeding.....	3

DIVISION 3 – CONCRETE

03315 Concrete for Utility Construction18

WATER PLANT SPECIFICATIONS

WP-201 Gravel Water Well14
WP-206 Deep Turbine Well Pump4
WP-210 Welded Steel Ground Storage Tank.....3
WP-212 Glass Lined Bolted Ground Storage Tank12
WP-215 Welded Steel Hydropneumatic Tank2
WP-225 Painting7
WP-230 Horizontal Split Case Booster Pumps.....3
WP-240 Chlorination System.....4
WP-275 Cleaning and Disinfection.....2
WP-520 Water Plant Piping4

DIVISION 16 – ELECTRICAL – See next page

APPENDIX

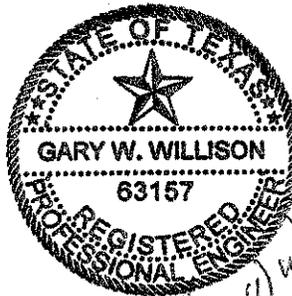
Geotechnical Report by LFC, Inc.29

END OF SECTION

TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL SPECIFICATIONS

16012	ELECTRICAL WORK.....	7
16111	CONDUIT, FITTINGS AND BODIES	9
16120	600-VOLT BUILDING WIRE AND CABLE	5
16131	DEVICE, PULL AND JUNCTION BOXES	3
16135	CABINETS, BOXES AND FITTINGS	7
16140	WIRING DEVICES	3
16150	ELECTRIC MOTORS	5
16195	ELECTRICAL IDENTIFICATION.....	8
16231	PACKAGED ENGINE GENERATORS	15
	RECOMMENDED GENERATOR REPORT	1
	LOADS AND STEPS DETAIL REPORT	4
16401	ELECTRIC SERVICE	2
16402	UNDERGROUND DUCT BANKS.....	4
16452	GROUNDING.....	9
16460	TRANSFORMERS	7
16470	PANELBOARDS	9
16475	OVERCURRENT PROTECTIVE DEVICES	13
16476	DISCONNECTS AND CIRCUIT BREAKERS	5
16481	MOTOR CONTROLLERS.....	8
16482	MOTOR-CONTROL CENTERS (600 V OR LESS).....	10
16496	AUTOMATIC TRANSFER SWITCH.....	8
16525	EXTERIOR LIGHTING	9
16622	SOUND ATTENUATING ENCLOSURE	3



Gary W. Willison
11/06/08



City of Tomball

Gretchen Fagan
Mayor

Jan Belcher
City Manager

NOTICE TO BIDDERS

The City of Tomball, Texas shall accept sealed proposals for "Water Supply & Storage Facility No. 5." The Bid Package may be obtained at the office of Cobb, Fendley & Associates, Inc. 13430 Northwest Fwy, Suite 1100, Houston, TX 77040, with a \$75.00 non-refundable charge for each complete set of documents obtained. All checks for bid package to be made out to Cobb, Fendley & Associates, Inc.

Sealed proposals shall be addressed to the City Purchasing Agent, City of Tomball, 501 James Street, Tomball, Texas 77375, and shall be labeled "**Project Number 2009-06, DO NOT OPEN**". Proposals shall be submitted no later than **2:00 p.m., Local Time on Wednesday, April 15, 2009.**

A pre-bid conference will be held on April 6, 2009, at 10:00 a.m. at the City of Tomball, Public Works Building, 501 James Street, Tomball, Texas 77375, to familiarize the Bidders with the goals for this project.

DRAWINGS and SPECIFICATIONS are on file at the following locations and may be examined without charge:

- Dodge Reports - 4101 Greenbriar Suite 320, Houston, Texas 77098
- Associated General Contractors - 3825 Dacoma, Houston, Texas 77092

Cashier's Check, Certified Check, or Bid Bond in an amount equal to five percent (5%) of the total amount bid must accompany the PROPOSAL. The Owner reserves the right to reject any or all bids or to accept any bid deemed advantageous to it and waive informalities in bidding. All bids received after the closing time designated will be returned unopened.

Upon consideration of the bids, the City of Tomball reserves the right to accept or to reject any and all bids, to waive technicalities and to make any investigation deemed necessary concerning the bidder's ability to provide the services as covered by the specifications, and to accept what in their judgment is the most advantageous bid.

Jan Belcher
Jan Belcher, City Manager

CERTIFICATION

I certify that the above "Notice to Bidders" was posted on the bulletin board of City Hall, City of Tomball, Texas on the 13th day of March 2009.

Doris Speer
Doris Speer, City Secretary

Section 00100

INSTRUCTIONS TO BIDDERS

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. To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit within five days of OWNER'S request written evidence, such as financial data, previous experience, present commitments, and other such data as may be called for by the OWNER. Each Bid must contain evidence of Bidder's qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the contract.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

- 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.

6. 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 at least ten (10) 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.

7. 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.

8. 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.

9. LIQUIDATED DAMAGES

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

10. 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).

11. 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.

12. 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. In case of ambiguity or lack of clearness in stating the prices tendered or the condition of the Bid, the OWNER reserves the right to consider the most favorable construction thereof or to reject the Bid from further consideration.
- 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).

13. 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.

14. 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.

15. 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.

16. 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.

17. AWARD OF CONTRACT

- A. Contract will be awarded on basis of low Base Bid. Selection of alternates or deductive Bid Items by the OWNER will not be used to displace the low Bidder.
- 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. After determination of Successful Bidder, OWNER reserves the right to modify the scope of the Work described in these Contract Documents. If the scope is reduced, the Contract price will be determined based on the unit prices bid. Successful Bidder may request to negotiate a revised unit price if the quantity for any bid item is reduced by greater than twenty-five percent (25%).
- 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.

18. 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.

19. 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).

20. 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.

21. 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.

17. 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.

Section 00300

BID FORM

TO: City of Tomball Public Works
501 James Street
Tomball, Texas 77375

PROJECT: Water Supply and Storage Facility No. 5

PROJECT NO.: 2006-10000

BIDDER: _____
(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 45 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
_____	_____
_____	_____
_____	_____

- 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 prices: (Note: All bid items are 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 which may not be specifically mentioned.

BASE UNIT PRICE ITEMS

ITEM NO.	SECTION NO.	ITEM DESCRIPTION	UNIT	QTY.	UNIT PRICE	TOTAL
1	n/a	Mobilization and Demobilization of Contractor(s) to the site	LS	1		
2	02921	Site Preparation, Final Grading and Turf Establishment Inclusive of Watering, Fertilizing, Mowing, and Maintenance Until a Stand of Bermuda Grass has been Established and Inspected and Accepted by the Engineer	LS	1		
3	02260	Trench Safety System (Complete in Place as per the Approved Construction Drawings and Contract Documents).	LF	4,600		
4	01410	Storm Water Pollution Prevention Plan Compliance Including but not limited to, Filter Fabric Fence, Placing & Removing Stabilized Construction Exit, SWPPP Implementation, Performing Project Site Inspections, Inspection Reports, Filing Notices, Posting Permits, Certificates & Notices, Installation of Control Measures & Maintenance of Existing Control Measure, etc.	LS	1		
5	02319	Clean Fill Borrow for Site Grading from Offsite Location (Complete in Place as per the Approved Construction Drawings and Contract Documents).	CY	500		
6	n/a	6 Foot High Chain Link Fence with 3-Strand Barbed Wire and 24 Foot Wide Electric Sliding Gate with all Appurtenances (Complete in Place as per the Approved Construction Drawings and Contract Documents).	LF	1,156		
7	03315	Drainage System Including swales, splash boxes, flume, and pipe (Complete in Place as shown on the plans and Approved Construction Drawings and Contract Documents).	LS	1		
8	02511	16-inch Offsite PVC Waterline, Open Cut, including Fittings, Fire Hydrants, with all Appurtenances (Complete in Place as shown on the plans and Approved Construction Drawings and Contract Documents).	LF	1,303		
9	02532	2-inch Offsite PVC Sewer Force Main, Open Cut, including Fittings with all Appurtenances (Complete in Place as shown on the plans and Approved Construction Drawings and Contract Documents).	LF	1,335		
10	02506	2-inch Offsite Natural Gas Main, Open Cut, including Fittings with all Appurtenances (Complete in Place as shown on the plans and Approved Construction Drawings and Contract Documents).	LF	1,405		

11	02532	Sewage Grinder Pump Station in 3-Foot Manhole (Complete in Place and Fully Operational and Functional, Including all Miscellaneous and Required Components and Appurtenances, as per the Construction Drawings and Contract Documents)	LS	1		
12	02330	Earthen Berm (Complete in Place as shown on the plans and Approved Construction Drawings and Contract Documents).	LS	1		
13	02754	6" Reinforced Concrete Access Drive w/6"Lime/Fly Ash Stabilized Subgrade (Complete in Place as shown on the Approved Construction Drawings and Contract Documents).	SY	1,150		
14	n/a	Gravel Access Road (Complete in Place as shown on the Approved Construction Drawings and Contract Documents)	SY	1,743		
15	WP-520	Water Plant Yard Piping Including, but Not Limited to, Well Discharge Inlet and Outlet Piping between Tanks and Booster Pump Pad, all Water Distribution Piping, Valves, and Fittings within the Water Plant Fence. (Complete in Place and Fully Operational Including all Components and Appurtenances per the Approved Construction Drawings and Contract Documents).	LS	1		
16	WP-201	Pilot Hole with a Depth of 950 Feet with Pilot Hole Drilling, Drill Cutting Sampling and Geophysical Logging with Well Completion Recommendations (Complete in Place and Fully Operational and Functional, Including all Miscellaneous and Required Components and Appurtenances, as per the Construction Drawings and Contract Documents)	LS	1		
17	WP-201	Pilot Hole Water Sampling and Chemical and Radionuclide Analyses Using a Small-Diameter Temporary Well and Gravel Pack Method with 36 hours of Development Using Airlift Pumping and Submersible Pump (Complete in Place and Fully Operational and Functional, Including all Miscellaneous and Required Components and Appurtenances, as per the Construction Drawings and Contract Documents)	EA	1		
18	WP-201	24-Inch x 18-Inch x 850-Foot Deep Gravel Wall Water Well (Evangeline Aquifer) 550 Feet of 24-Inch Casing, 100 Feet of 18-Inch Screen and 200 Feet of 18-Inch Blank Liner with Reinforced Concrete Well Base Foundation, (Complete in Place and Fully Operational and Functional, Including Well Development, Testing and Certifications; Including all Miscellaneous and Required Components and Appurtenances, as per the Approved Construction Drawings and Contract Documents).	LS	1		

19	WP-201	1,500 GPM Deep Well Vertical Turbine Water Well Pump and 300 hp Motor (Complete in Place and Fully Operational and Functional, Well Development, Testing and Certifications; Including all Miscellaneous and Required Components and Appurtenances, as per the Construction Drawings and Contract Documents)	LS	1		
20	WP-230	1,000 GPM Horizontal Split-Case Booster Pump and 50hp Motor (Complete in Place and Fully Operational and Functional Including all Appurtenances as per the Approved Construction Drawings and Contract Documents)	EA	3		
21	03315	Booster Pump Pad (Complete in Place as shown on the Approved Construction Drawings and Contract Documents)	LS	1		
22	WP-210	500,000 gallon (minimum capacity) Welded Steel Ground Storage Tank (Painted), Complete with Reinforced Concrete Foundation (Complete in Place with all Appurtenances as per the Approved Construction Drawings and Construction Documents).	EA	1		
23	WP-215	One 5,000 Gallon Welded and Painted Hydropneumatic Tank Including , but not Limited to Reinforced Concrete Foundation, Air Compressor, Air Piping and Pressure Sensory Equipment (Complete in Place and Fully Operational, Including all Appurtenances, as per the Approved Construction Drawings and Contract Documents).	EA	1		
24	16012	Complete Electrical System Including, but not limited to, Control Panel, Electrical Controls, Electric Service, Auto Dialer, Fans, Air Conditioner, Interior and Exterior Lighting. (Complete in Place and Fully Operational Including all Components and Appurtenances per the Approved Construction Drawings and Contract Documents).	LS	1		
25	n/a	Concrete Block Building and Foundation to House the Motor Control Center, Disinfection and Bathroom Facilities (Complete in Place Including all Miscellaneous Components and Appurtenances per the Approved Construction Drawings and Contract Documents).	LS	1		
26	WP-240	Chlorine Disinfection System Including, but not Limited to Chlorination, Scales, Miscellaneous Equipment and Piping and Four (4) Full 150 lb Gas Cylinders. (Complete in Place and Fully Operational Including all Components and Appurtenances per the Approved Construction Drawings and Contract Documents).	LS	1		

27	16231	An 800 kw Natural Gas Generator with 1600Amp Automatic Transfer Switch, Reinforced Concrete Foundation (Complete in Place as shown on the Approved Construction Drawings and Contract Documents).	LS	1		
		TOTAL BASE BID				
ALTERNATE UNIT PRICE ITEMS						
1	WP-212	500,000 Gallon Glass Lined Ground Storage Tank, Concrete Foundation, Connection to Yard Piping and Drainage System, Sterilization and Testing, replacing base bid Steel Ground Storage Tank	LS	1		
2	16231	A 750 kw Diesel Generator with 1600Amp Automatic Transfer Switch, 8 Hour Fuel Storage Tank, Reinforced Concrete Foundation, replacing base bid Natural Gas Generator (Complete in Place as shown on the Approved Construction Drawings and Contract Documents).	LS	1		
3	WP-241	Fluoridation System, Including, but not Limited to Bulk Storage Tank, Fluorosilicic Day Tank, Transfer Pump, Scale, and Metering Pump. (Complete in Place and Fully Operational Including all Components and Appurtenances per the Approved Construction Drawings and Contract Documents).	LS	1		
4	WP-242	Liquid Phosphate System Including, but not Limited to Phosphate, 55 Gallon Drum, Metering Pump and Piping, Valves, and all necessary appurtenances. (Complete in Place and Fully Operational Including all Components and Appurtenances per the Approved Construction Drawings and Contract Documents).	LS	1		
5	WP-201	Plug and Abandon Pilot Hole to meet specifications and TDLR, TCEQ, and HGSD rules	LS	Add		
6	WP-201	24-inch Surface Casing as required, more or less than 550 feet base bid length	VF	Add/ Deduct		
7	WP-201	18-inch Production Screen, as required, more or less than 100 feet base bid length	VF	Add/ Deduct		
8	WP-201	18-inch Blank Production Liner as required, more or less than 200 feet base bid length	VF	Add/ Deduct		
9	WP-201	550 feet of 20-inch Surface Casing as a substitute for 24-inch surface casing	LS	Deduct		
10	WP-201	32-inch Diameter Underream of Pilot Hole	LS	Add		
11	WP-201	Additional Water Sample	Ea	Add		
12	WP-201	Perform Spectralog of Pilot hole upon the request of the Engineer	LS	Add		
13	16150	Increase the Horsepower of the Electric Water Well	LS	Add		

		Pump Motor by 50 hp				
14	16150	Decrease the Horsepower of the Electric Water Well Pump Motor by 50 Hp	LS	Deduct		
TOTAL ALTERNATE BID						

5. OWNER reserves the right to modify the scope of Work after opening of Bid. If the scope is modified, the unit prices bid may not be revised unless the quantity for that bid item is reduced by greater than twenty-five percent (25%).
6. OWNER reserves the right to abandon the project if the pilot hole analysis is not conducive to providing public water supply. If this occurs, the BIDDER will be paid for work performed on the pilot hole by Base Bid Items 16 and 17, and Alternate Bid Item 5. Abandonment of the project will not be considered a work change directive or change order.
7. 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.
8. 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.
9. Communications concerning this Bid shall be addressed to the business address of BIDDER indicated herein.
10. 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 _____, 20__.

Bidder:

(Print or type full name of your proprietorship, partnership, corporation, or joint venture.)*

**By:

Signature

Date

Name:

(Print or type name)

Title

Address:

(Mailing)

(Street, if different)

Telephone and Fax Number:

(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 the _____ day of _____ in the year _____ by and between City of Tomball (hereinafter called OWNER) and _____, (hereinafter called CONTRACTOR).

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

Article 1. WORK

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

Construction of a 1,500 gpm water well, a 500,000 gallon ground storage tank, three 1,000 gpm booster pumps with piping, a 5,000 gallon hydropneumatic tank, disinfection systems, motor control center, emergency power natural gas generator, 2-inch offsite gas line, 16-inch offsite water line, sanitary grinder pump station with off-site 4-inch sanitary force main, and all site work related to water plant facility.

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 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 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 proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER 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 bid for the awarded items is \$ _____.

The quantities and totals on unit price items shown on the CONTRACTOR'S Bid are approximate. Payment of Work covered by the unit price items will be made only on the basis of actual quantities of Work complete in place as authorized and as measured as provided in the Contract Documents.

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 accept 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.

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 (pages 00500-1 to 00500-5, inclusive).
- 8.2 Performance and other Bonds
- 8.3 Notice of Award
- 8.4 General Conditions (pages GC-1 thru GC-41, inclusive)
- 8.5 Specifications bearing the title "Contract Documents and Technical Specifications for the Water Supply and Storage Facility No. 5".
- 8.6 Addenda number ___.
- 8.7 CONTRACTOR'S Bid (pages 00300-1 to 00300-4, inclusive).
- 8.8 Documentation submitted by CONTRACTOR prior to Notice of Award.
- 8.9 Certificate of Insurance.
- 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 13. 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

CONTRACTOR:

CITY OF TOMBALL

By: _____

By: _____

(CORPORATE SEAL)

(CORPORATE SEAL)

Attest: _____

Attest: _____

Address for giving notice:

Address for giving notice:

401 West Market Street
Tomball, Texas 77375

License No. _____

Agent for service of process:

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

END OF SECTION

Section 00610

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That _____ of the City of _____ of _____ county, and State of _____, as principal, and _____, 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 Tomball (Owner), in the penal sum of _____ 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 _____ day of _____, 20__ for the construction of the Water Supply and Storage Facility No. 5, which Contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

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 _____ day of _____, 20__.

Contractor

Surety

By: _____

By: _____

Title: _____

Title: _____

Address: _____

Address: _____

The name and address of the Resident Agent of Surety is:

END OF SECTION

Section 00620

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That _____ of the City of _____ of _____ County, and State of _____, as principal, and _____, 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 Tomball (Owner), in the penal sum of _____ 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 _____ day of _____, 20__ for the construction the Water Supply and Storage Facility No. 5, which Contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

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 _____ day of _____, 20____.

Contractor

Surety

By: _____

By: _____

Title: _____

Title: _____

Address: _____

Address: _____

The name and address of the Resident Agent of Surety is:

END OF SECTION

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

Issued and Published Jointly by

ACEC

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ASCE American Society
of Civil Engineers



**National Society of
Professional Engineers**
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Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

Associated General Contractors of America
2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308
(703) 548-3118
www.agc.org

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

	Page
Article 1 – Definitions and Terminology	1
1.01 Defined Terms.....	1
1.02 Terminology.....	5
Article 2 – Preliminary Matters	6
2.01 Delivery of Bonds and Evidence of Insurance	6
2.02 Copies of Documents.....	6
2.03 Commencement of Contract Times; Notice to Proceed.....	6
2.04 Starting the Work	7
2.05 Before Starting Construction	7
2.06 Preconstruction Conference; Designation of Authorized Representatives.....	7
2.07 Initial Acceptance of Schedules.....	7
Article 3 – Contract Documents: Intent, Amending, Reuse	8
3.01 Intent.....	8
3.02 Reference Standards.....	8
3.03 Reporting and Resolving Discrepancies.....	9
3.04 Amending and Supplementing Contract Documents.....	9
3.05 Reuse of Documents	10
3.06 Electronic Data.....	10
Article 4 – Availability of Lands; Subsurface and Physical Conditions; Hazardous Environmental Conditions; Reference Points.....	11
4.01 Availability of Lands.....	11
4.02 Subsurface and Physical Conditions.....	11
4.03 Differing Subsurface or Physical Conditions	12
4.04 Underground Facilities.....	13
4.05 Reference Points.....	14
4.06 Hazardous Environmental Condition at Site.....	14
Article 5 – Bonds and Insurance.....	16
5.01 Performance, Payment, and Other Bonds.....	16
5.02 Licensed Sureties and Insurers.....	16
5.03 Certificates of Insurance	17
5.04 Contractor’s Insurance	17
5.05 Owner’s Liability Insurance.....	19
5.06 Property Insurance.....	19
5.07 Waiver of Rights	20
5.08 Receipt and Application of Insurance Proceeds	21

5.09	Acceptance of Bonds and Insurance; Option to Replace	21
5.10	Partial Utilization, Acknowledgment of Property Insurer	22
Article 6 – Contractor’s Responsibilities		22
6.01	Supervision and Superintendence.....	22
6.02	Labor; Working Hours	22
6.03	Services, Materials, and Equipment	22
6.04	Progress Schedule	23
6.05	Substitutes and “Or-Equals”	23
6.06	Concerning Subcontractors, Suppliers, and Others.....	25
6.07	Patent Fees and Royalties	27
6.08	Permits.....	27
6.09	Laws and Regulations	28
6.10	Taxes	28
6.11	Use of Site and Other Areas.....	28
6.12	Record Documents	29
6.13	Safety and Protection	29
6.14	Safety Representative.....	30
6.15	Hazard Communication Programs.....	30
6.16	Emergencies	30
6.17	Shop Drawings and Samples	31
6.18	Continuing the Work.....	32
6.19	Contractor’s General Warranty and Guarantee	33
6.20	Indemnification	33
6.21	Delegation of Professional Design Services.....	34
Article 7 – Other Work at the Site		35
7.01	Related Work at Site	35
7.02	Coordination.....	35
7.03	Legal Relationships.....	36
Article 8 – Owner’s Responsibilities.....		36
8.01	Communications to Contractor.....	36
8.02	Replacement of Engineer	36
8.03	Furnish Data	36
8.04	Pay When Due.....	36
8.05	Lands and Easements; Reports and Tests.....	36
8.06	Insurance.....	36
8.07	Change Orders.....	37
8.08	Inspections, Tests, and Approvals	37
8.09	Limitations on Owner’s Responsibilities	37
8.10	Undisclosed Hazardous Environmental Condition	37
8.11	Evidence of Financial Arrangements.....	37
8.12	Compliance with Safety Program	37
Article 9 – Engineer’s Status During Construction.....		37
9.01	Owner’s Representative	37

9.02	Visits to Site	37
9.03	Project Representative.....	38
9.04	Authorized Variations in Work	38
9.05	Rejecting Defective Work.....	38
9.06	Shop Drawings, Change Orders and Payments	39
9.07	Determinations for Unit Price Work	39
9.08	Decisions on Requirements of Contract Documents and Acceptability of Work	39
9.09	Limitations on Engineer's Authority and Responsibilities	39
9.10	Compliance with Safety Program	40
Article 10 – Changes in the Work; Claims		40
10.01	Authorized Changes in the Work	40
10.02	Unauthorized Changes in the Work.....	41
10.03	Execution of Change Orders	41
10.04	Notification to Surety	41
10.05	Claims.....	41
Article 11 – Cost of the Work; Allowances; Unit Price Work		42
11.01	Cost of the Work	42
11.02	Allowances	45
11.03	Unit Price Work	45
Article 12 – Change of Contract Price; Change of Contract Times		46
12.01	Change of Contract Price	46
12.02	Change of Contract Times	47
12.03	Delays	47
Article 13 – Tests and Inspections; Correction, Removal or Acceptance of Defective Work.....		48
13.01	Notice of Defects.....	48
13.02	Access to Work	48
13.03	Tests and Inspections	49
13.04	Uncovering Work.....	49
13.05	Owner May Stop the Work.....	50
13.06	Correction or Removal of Defective Work	50
13.07	Correction Period	50
13.08	Acceptance of Defective Work.....	51
13.09	Owner May Correct Defective Work	52
Article 14 – Payments to Contractor and Completion		52
14.01	Schedule of Values.....	52
14.02	Progress Payments	52
14.03	Contractor's Warranty of Title.....	55
14.04	Substantial Completion.....	55
14.05	Partial Utilization	56
14.06	Final Inspection	57
14.07	Final Payment.....	57
14.08	Final Completion Delayed.....	58

14.09 Waiver of Claims	58
Article 15 – Suspension of Work and Termination	59
15.01 Owner May Suspend Work.....	59
15.02 Owner May Terminate for Cause	59
15.03 Owner May Terminate For Convenience	60
15.04 Contractor May Stop Work or Terminate.....	60
Article 16 – Dispute Resolution	61
16.01 Methods and Procedures	61
Article 17 – Miscellaneous	61
17.01 Giving Notice	61
17.02 Computation of Times	62
17.03 Cumulative Remedies	62
17.04 Survival of Obligations	62
17.05 Controlling Law	62
17.06 Headings	62

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor 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.

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.

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

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:*

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.

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 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:*

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
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 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
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 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 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 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.
- 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.
- 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:
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:
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 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 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.

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.

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.

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
 - 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 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.

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 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 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.
- 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.

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 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:
 - 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, 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.

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.

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.

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

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

9.03 *Project Representative*

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

9.04 *Authorized Variations in Work*

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

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

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

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

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor 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.

- 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.

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 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 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.
- 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, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not

limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
 1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance:*
 1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to

the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - 2. there is no corresponding adjustment with respect 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;
 - 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 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.
- 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.

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 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 equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

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

14.02 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an

Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations 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
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

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

D. Reduction in Payment:

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor 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 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.

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:*

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

14.08 *Final Completion Delayed*

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

14.09 *Waiver of Claims*

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

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

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

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's 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.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 - 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
 - 4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days

to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

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

ARTICLE 16 – DISPUTE RESOLUTION

16.01 Methods and Procedures

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
 2. agrees with the other party to submit the Claim to another dispute resolution process; or
 3. gives written notice to the other party of 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.

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.

SUPPLEMENTARY CONDITIONS

SECTION 00800

SUPPLEMENTARY CONDITIONS

(TO ACCOMPANY STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT,
EJCDC NO. C-700 [2007 EDITION] FOR CITY OF TOMBALL CONSTRUCTION PROJECTS)

TABLE OF CONTENTS

PART I . AMENDMENTS TO GENERAL CONDITIONS

<u>Article</u>	<u>Title</u>
1	DEFINITIONS
2	PRELIMINARY MATTERS
4	AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS
5	BONDS AND INSURANCE
6	CONTRACTOR'S RESPONSIBILITIES
7	OTHER WORK
8	OWNER'S RESPONSIBILITIES
9	ENGINEER'S STATUS DURING CONSTRUCTION
10	CHANGES IN THE WORK; CLAIMS
13	TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK
14	PAYMENTS TO CONTRACTOR AND COMPLETION
15	SUSPENSION OF WORK AND TERMINATION
18	WAGE RATES

PART II . OTHER PROVISIONS

EXHIBIT A	Wage Rates
EXHIBIT B	Worker's Compensation Insurance Coverage
EXHIBIT C	A Listing of the Duties, Responsibilities, and Limitations of Authority of the Resident Project Representative
EXHIBIT D	Addenda (if any)
EXHIBIT E	Change Order (form)
EXHIBIT F	Application for Payment (form)
EXHIBIT G	Storm Water Pollution Prevention Plan

SECTION 00800

SUPPLEMENTARY CONDITIONS

PART I AMENDMENTS TO GENERAL CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (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 1 DEFINITIONS

SC-1.01

The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract (General Conditions) have the meanings assigned to them in the General Conditions.

Amend Paragraph 1.01 .A.19, Engineer, of the General Conditions by adding the following to the end:

"For this project the following named persons, firms, or corporations have been utilized by ENGINEER to furnish services as a consultant with respect to the project (if blank, none have been utilized by the ENGINEER):

1. Coastal Bend Consultants
2. _____
3. _____

ARTICLE 2 PRELIMINARY MATTERS

SC-2.02

Amend the first sentence of Paragraph 2.02.A of the General Conditions to read as follows:

"Five sets of the Contract Documents shall be furnished to the CONTRACTOR, at no charge, for construction purposes."

And so amended, Paragraph 2.02 remains in effect.

SC-2.03

In Paragraph 2.03 of the General Conditions, the Contract Times commence to run no later than the 85 days after the bids are opened, in lieu of 60 days.

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

SC-4.02

In the preparation of Drawings and Specifications, ENGINEER or ENGINEER's Consultants have relied upon:

4.02.A.1 The following reports of exploration and tests of subsurface conditions at the site of the Work (if blank, no reports or tests were used by ENGINEER or ENGINEER's Consultants):

1. Potential Pollution Hazards Study by Raba Kistner
2. Geotechnical Engineering Report by LFC, Inc.

The technical data contained in such reports upon which the CONTRACTOR may rely is

4.02.A.2 The following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the site of Work:

1. _____
2. _____
3. _____

All of the information in such drawings constitutes technical data on which CONTRACTOR may rely with the following exceptions: _____

Copies of these reports and drawings that are not included with the Bidding Documents may be examined at the office of the ENGINEER during regular business hours. These reports and drawings are not part of the Contract Documents, but the technical data contained therein upon which CONTRACTOR is entitled to rely as provided in GC-4.02.B and as identified and established above are incorporated therein by reference. CONTRACTOR is not entitled to rely upon other information and data utilized by ENGINEER.

SC-4.06

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

ARTICLE 5 BONDS AND INSURANCE

SC-5.01

Delete Paragraphs 5.01.A and 5.01.B of the General Conditions in their entirety and insert the following in their place:

"A. The Successful Bidder must furnish with the executed Contract Documents a Performance Bond and a Payment Bond on the forms furnished with the Contract Documents, each in the amount of 100% of the total Contract Price. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. The surety company must be authorized to do business in Texas, which authorization must be recorded in the files of the State Board of Insurance. The surety company must be authorized to issue Payment and Performance Bonds in the amount required for the particular Contract, which authorization must be recorded in the files of the State Board of Insurance. The surety company must have a rating of at least "B" in the current Best's Key Rating Guide, or if the surety company does not have such a rating due to the length of time it has existed, the surety company must be eligible to participate in the surety bond guarantee program of the Small Business Administration and must be an approved surety listed in the current U.S. Department of Treasury Circular 570, and must meet all of the related rules and regulations of the Treasury Department. The person executing the Payment and Performance Bonds must be a licensed Texas local recording agent, and such licensing must be recorded in the files of the State Board of Insurance. The person executing the Payment and Performance Bonds must be authorized by the surety company to execute Payment and Performance Bonds on behalf of the company in the amount required for the Contract, and such authorization must be recorded in the files of the State Board of Insurance. The Contract shall not be in effect until such Bonds have been provided by the CONTRACTOR and accepted by the OWNER."

SC-5.04

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:

Worker's Compensation

- (1) State: Statutory
- (2) Applicable Federal (e.g., Longshoreman's): Statutory
- (3) Employer's Liability:
 - \$500,000 Each Accident
 - \$500,000 Disease - Policy Limit
 - \$500,000 Disease - Each Employee

Commercial General Liability

- (1) General Aggregate Limit (other than products-completed operations) coverage must include Explosion, Collapse, and Underground Coverages \$1,000,000
- (2) Products-Completed Operations Aggregate Limit \$1,000,000
- (3) Each Occurrence Limit \$ 500,000

Commercial Automobile Liability

\$500,000 Any One Loss or Accident

Umbrella Liability

\$1,000,000 Excess Limit

Shortages in coverage in any of the areas listed above may be covered by additional umbrella coverage.

SC-5.06

Delete Paragraphs 5.06, 5.07, and 5.08 of the General Conditions in their entirety.

SC-5.09

Delete Paragraph 5.09 of the General Conditions in its entirety and insert the following in its place:

"A. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with Article 5 on the basis of its not complying with the Contract Documents, OWNER shall notify CONTRACTOR in writing. OWNER and CONTRACTOR shall each provide to the other such information in respect of insurance provided by each as the other may reasonably request."

ARTICLE 6 CONTRACTOR'S RESPONSIBILITIES

SC-6.06

Delete Paragraph 6.06.G of the General Conditions in its entirety and insert the following in its place:

"G. All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate Agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER."

Add a new paragraph immediately after Paragraph 6.06.G of the General Conditions which is to read as follows:

"6.06.H OWNER or ENGINEER may furnish to any such Subcontractor, Supplier, or other person or organization, to the extent practicable, information about amounts paid to CONTRACTOR in accordance with CONTRACTOR's Applications for Payment on account of the particular Subcontractor's, Supplier's, other person's, or other organization's Work."

SC-6.10

Delete Paragraph 6.10 of the General Conditions in its entirety and insert the following in its place:

"A. The CONTRACTOR's attention is directed to Paragraph No. 3 of Ruling No. 9, Repairmen and Contractors (as amended) issued by the Comptroller of Public Accounts. Reference Article 20.01 (T), Limited Sales, Excise, and Use Tax and to subsequent applicable legislation. The OWNER requires that no sales tax be paid on any materials incorporated into the completed Work on this Project. All Bidders and their respective Subcontractors must comply with Paragraph No. 3 of Ruling No. 9 by obtaining the necessary permit or permits from the State Comptroller allowing the purchase of materials for incorporation into this Project without having to pay the Limited Sales, Excise, and Use Tax at the time of purchase. Total materials cost should not include materials which are used up or consumed in performing the Work, but which do not become a part of this proposed Work."

SC-6.16

Amend the third sentence of Paragraph 6.16 of the General Conditions to read as follows:

"If ENGINEER and OWNER determine 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."

And so amended, Paragraph 6.16 remains in effect.

SC-6.22

Amend Article 6 of the General Conditions by inserting the following Paragraph 6.22:

"6.22 LOSSES FROM NATURAL CAUSES:

- A. All loss or damage to the CONTRACTOR arising out of the nature of the Work to be done, or from the action of the elements, or from any unforeseen circumstance in the prosecution of the same, or from unusual obstructions or difficulties which may be encountered in the prosecution of the Work, shall be sustained and borne by the CONTRACTOR at his own cost and expense."

ARTICLE 7 OTHER WORK

SC-7.02

Delete Paragraphs 7.02.A and 7.02.B of the General Conditions in their entirety and insert the following in its place:

- "A. If OWNER contracts with others for the performance of other Work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors shall be the OWNER's Representative. The extent of the authority and responsibility of the OWNER's Representative will be as specified in the Contract Documents."

SC-7.03

Add a new paragraph following 7.02 of the General Conditions which is to read as follows:

"SC-7.03 Should CONTRACTOR cause damage to the work or property of any separate contractor at the site, or should any claim arising out of CONTRACTOR's performance of the Work at the site be made by any separate contractor against CONTRACTOR, OWNER, ENGINEER, ENGINEER's Consultants, the Construction Coordinator, or any other person, CONTRACTOR shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by arbitration or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold OWNER, ENGINEER, ENGINEER's Consultants, and the Construction Coordinator harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals, and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any separate contractor against OWNER, ENGINEER, ENGINEER's Consultants or the Construction Coordinator to the extent based on a claim arising out of CONTRACTOR's performance of the Work. Should a separate contractor cause damage to the Work or property of CONTRACTOR or should the performance of Work by any separate contractor at the site give rise to any other claim, CONTRACTOR shall not institute any action, legal or equitable, against OWNER, ENGINEER, ENGINEER's Consultants, or the Construction Coordinator or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from OWNER, ENGINEER, ENGINEER's Consultants, or the Construction Coordinator on account of any such damage or claim. If CONTRACTOR is delayed at any time in performing or furnishing Work by any act or neglect of a separate contractor and OWNER and CONTRACTOR are unable to agree as to the extent of any adjustment in Contract Times attributable thereto,

CONTRACTOR may make a claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be CONTRACTOR's exclusive remedy with respect to OWNER, ENGINEER, ENGINEER's Consultants, and Construction Coordinator for any delay, disruption, interference, or hindrance caused by any separate contractor. This paragraph does not prevent recovery from OWNER, ENGINEER, ENGINEER's Consultant, or Construction Coordinator for activities that are their respective responsibilities.

ARTICLE 8 OWNER'S RESPONSIBILITIES

SC-8.02

Amend Paragraph 8.02 of the General Conditions to read as follows:

"In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer whose status under the Contract Documents shall be that of the former ENGINEER."

And so amended, Paragraph 8.02 remains in effect.

SC-8.06

Delete Paragraph 8.06 of the General Conditions in its entirety.

ARTICLE 9 ENGINEER'S STATUS DURING CONSTRUCTION

SC-9.01

Amend the second sentence of Paragraph 9.01 of the General Conditions to read as follows:

"The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and will not be changed except by written direction of OWNER."

And so amended, Paragraph 9.01 remains in effect.

SC-9.04

Delete the third sentence of Paragraph 9.04, Authorized Variations in Work, of the General Conditions in its entirety, and so amended, Paragraph 9.04 remains in effect.

ARTICLE 10 CHANGES IN THE WORK; CLAIMS

SC-10.03

Amend the first sentence of Paragraph 10.03.A of the General Conditions to read as follows:

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

And so amended, Paragraph 10.03 remains in effect.

SC-10.05

Amend the first sentence of Paragraph 10.05.B., Claims – Notice, of the General Conditions shall be amended by changing "30 days" to read "fourteen (14) calendar days"

Amend Paragraph 10.05.E by deleting it in its entirety.

And so amended, Paragraph 10.05 remains in effect.

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

SC-13.04

Amend the first sentence of Paragraph 13.04.B of the General Conditions to read as follows:

"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 and with OWNER's written approval, 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."

And so amended, Paragraph 13.04 remains in effect.

SC-13.07

Delete Paragraph 13.07.D of the General Conditions in its entirety and insert the following in its place:

"D. Notwithstanding any other provision of this section or the Contract Documents to the contrary, this provision shall not serve to limit any causes of action which the OWNER may have against the CONTRACTOR for Defective Work or for otherwise failing to fulfill CONTRACTOR's obligations under the Contract Documents; nor shall this provision serve to limit the time in which such causes of action shall be asserted."

SC-13.09

Amend the second sentence of Paragraph 13.09.B of the General Conditions to read as follows:

"In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work and suspend CONTRACTOR's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere."

And so amended, Paragraph 13.09 remains in effect.

ARTICLE 14 PAYMENTS TO CONTRACTOR AND COMPLETION

SC-14.02

Amend Paragraph 14.02.D.1.b of the General Conditions to read as follows:

"Claims or 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;"

Add Paragraph 14.02.D.1.e to the General Conditions to read as follows:

"OWNER concludes that one or more of the events enumerated in Paragraph 14.02.B.2.a through 14.02.B.2.c have not occurred."

And so amended, Paragraph 14.02 remains in effect.

SC-14.03

Amend Paragraph 1 4.03.A of the General Conditions to read as follows:

"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 or Claims."

And so amended, Paragraph 14.03 remains in effect.

SC-14.04

Insert prior to the first sentence of Paragraph 1 4.04.A of the General Conditions the following:

"Substantial completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the OWNER can occupy or utilize the Work for its intended use."

And so amended, Paragraph 14.04 remains in effect.

SC-14.07

Amend Paragraph 1 4.07.A.2.(iii) of the General Conditions to read as follows:

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

Amend Paragraph 1 4.07.A.3 of the General Conditions to read as follows:

"In lieu of the releases or waivers of Liens and Claims specified in Paragraph 1 4.07.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 or Claim could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien or Claim."

Amend Paragraph 14.07.C.1 of the General Conditions to read as follows:

"If OWNER concurs with ENGINEER's recommendation, thirty days after the presentation to OWNER of the Application for Payment and accompanying documentation, the amount recommended by ENGINEER will become due and, when due, will be paid by OWNER to CONTRACTOR."

And so amended, Paragraph 14.07 remains in effect.

SC-14.09

Amend Paragraph 14.09.A.1 of the General Conditions to read as follows:

"a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens or Claims of laborers and materialmen, 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"

And so amended, Paragraph 14.09 remains in effect.

ARTICLE 15 SUSPENSION OF WORK AND TERMINATION

SC-15.02

Amend Paragraph 15.02.A.1 of the General Conditions to read as follows:

"CONTRACTOR's 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);"

Amend the first sentence of Paragraph 15.02.B of the General Conditions to read as follows:

"If one or more of the events identified in Paragraph 15.02.A occur, OWNER may, after giving CONTRACTOR (and the surety, if any) seven days written notice, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site and take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient."

And so amended, Paragraph 15.02 remains in effect.

SC-16.01

Amend Paragraph 16.01 A. of the General Conditions by deleting the second and third sentences in their entirety.

Amend Paragraph 16.01 B. of the General Conditions by deleting it in its entirety.

Amend "ARTICLE 17 MISCELLANEOUS PROVISIONS of the General Conditions to add the following provisions:

- 17.07 WAGE RATES. The prevailing wage rates for this project are included as Exhibit A to the Supplementary Conditions and are hereby made a part of the Contract Documents by reference. Wages not less than these rates must be paid on this project, including fringe benefits. The CONTRACTOR shall post the Prevailing Wage Rate Determination in a prominent and easily accessible location at the project site and shall abide by all associated laws and regulations pertaining thereto.
- 17.08 LIQUIDATED DAMAGES. The Owner will suffer financial loss in an amount that is difficult to quantify if the Project is not Substantially Completed on the date set forth in the Contract Documents. The Owner may assess liquidated damages against the Contractor (and its surety) in an amount equal to .5% of the Contract per week for each project, as fixed, agreed and liquidated damages and not a penalty, for each calendar day of delay until the Work is Substantially Completed. In the event liquidated damages are caused by the Contractor and another entity, the Owner may reasonably apportion damages. The right to assess liquidated damages is in addition to, and not in limitation of, any right or remedy available to the Owner."
- 17.09 VENUE. This Agreement is governed by the laws of the State of Texas. The parties agree that venue for any litigation arising out of this Agreement shall lie exclusively in the State and Federal Courts in Harris County, Texas.
- 17.10 NO THIRD PARTY BENEFICIARIES The signing parties to this agreement do not intend to confer any rights upon any persons not a party to this Contract; accordingly this contract shall not be construed to create any third party beneficiaries."

PART II OTHER PROVISIONS

The following additional items are attached to this section.

1. Exhibit A, Wage Rates
2. Exhibit B, Worker's Compensation Insurance Coverage
3. Exhibit C, A Listing of the Duties, Responsibilities, and Limitations of Authority of the Resident Project Representative
4. Exhibit D, Addenda (if any)
5. Exhibit E, Change Order (form)
6. Exhibit F, Application for Payment (form)
7. Exhibit G, Storm Water Pollution Prevention Plan

END OF SECTION 00800

Section 00800

EXHIBIT A – WAGE RATES FOR ENGINEERING CONSTRUCTION

1.01 In accordance with the Prevailing Wage Law on Public Works (Chapter 2258 of the Texas Government Code), the public body awarding the Contract does hereby specify the 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 5 feet from an exterior wall of new building under construction or from an exterior wall of an existing building.

**LABOR CLASSIFICATIONS AND PREVAILING WAGE RATES FOR ENGINEERING
CONSTRUCTION**

Classification	Prevailing Rate
Air Tool Man	\$6.70
Paving Sub Grader	\$6.65
Asphalt Raker	\$7.05
Asphalt Shoveler	\$6.20
Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel (Less than 1-1/2 CY)	\$8.25
Batching Plant Scaleman	\$7.75
Carpenter, Rough	\$9.25
Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel (1-1/2 CY & Over)	\$9.50
Carpenter Helper, Rough	\$7.00
Crusher or Screening Plant Operator	\$9.50
Concrete Finisher (Paving)	\$7.80
Elevating Grader	\$8.00
Concrete Finisher Helper (Paving)	\$5.95
Foundation Drill Oper., Truck Mounted	\$9.00
Concrete Finisher (Strs.)	\$7.95
Front End Loader (2-1/2 CY & Less)	\$7.30
Concrete Finisher Helper (Strs.)	\$6.45
Front End Loader (Over 2-1/2 CY)	\$8.25
Concrete Rubber	\$7.00
Mixer (Concrete Paving)	\$8.00
Electrician	\$13.95
Motor Grader Operator, Fine Grade	\$8.95
Electrician Helper, Senior	\$9.90
Motor Grader Operator	\$8.15
Electrician Helper, Junior	\$7.85
Form Builder (Strs.)	\$8.00
Roller, Steel Wheel (Plant-Mix Pavement)	\$7.35
Form Builder Helper (Strs.)	\$5.95
Form Liner (Pvg. & Curb)	\$8.05
Roller, Steel Wheel (Other Flat Wheel or Tamping)	\$7.20
Form Setter (Pvg. & Curb)	\$7.20
Roller, Pneumatic Self-Propelled	\$6.50
Form Setter Helper (Pvg. & Curb)	\$5.75
Scrapers (17 CY & Less)	\$6.55
Form Setter (Strs.)	\$7.35
Scrapers (Over 17 CY)	\$7.60
Form Setter Helper (Strs.)	\$6.25
Self-Propelled Hammer Operator	\$7.80
Laborer, Common	\$5.30
Tractor (Crawler Type) 150 HP & Less	\$7.70
Laborer, Utility Man	\$6.25
Tractor (Crawler Type) Over 150 HP	\$8.50
Manhole builder, Brick	\$6.85
Tractor (Pneumatic) 80 HP & Less	\$6.35

Classification	Prevailing Rate
Mechanic	\$9.85
Tractor (Pneumatic) Over 80 HP	\$7.50
Mechanic Helper	\$7.50
Trenching Machine, Light	\$7.00
Oiler	\$7.00
Serviceman	\$7.60
Wagon-Drill, Boring Machine or Post Hole Driller Operator	\$9.50
Piledriverman	\$8.45
Reinforcing Steel Setter (Paving)	\$6.85
Pipe Layer	\$6.75
Reinforcing Steel Setter (Strs.)	\$8.20
Pipe Layer Helper	\$5.75
Reinforcing Steel Setter Helper	\$6.25
Steel Worker (Strs.)	\$7.95
POWER EQUIPMENT OPERATORS:	
Steel Worker Helper (Strs.)	\$6.30
Asphalt Distributor	\$7.75
Spreader Box Man	\$7.50
Asphalt Paving Machine	\$8.45
Broom or Sweeper Operator	\$6.25
TRUCK DRIVERS:	
Bulldozer, 150 HP & Less	\$7.40
Single Axle, Light	\$6.40
Bulldozer, Over 150 HP	\$8.55
Single Axle, Heavy	\$6.75
Concrete Paving Curing Machine	\$7.45
Tandem Axle or Semi-Trailer	\$7.15
Concrete Paving Finishing Machine	\$8.35
Lowboy-Float	\$7.90
Concrete Paving Form Grader	\$7.50
Transit-Mix	\$7.00
Concrete Paving Grinder	\$7.35
Winch	\$5.90
Concrete Paving Joint Machine	\$7.30
Welder	\$8.40
Concrete Paving Joint Sealer	\$7.85
Welder Helper	\$8.00
Concrete Paving Saw	\$7.50
Concrete Paving Spreader	\$7.55
Craft Level Prevailing Rate:	
Water Well Driller Journeyman	\$9.83
Water Well Driller Helper	\$7.33
Water Pump Installer Journeyman	\$9.67
Water Pump Installer Helper	\$7.33
Elevated Tank Painter Journeyman	\$13.19
Elevated Tank Painter Helper	\$8.26
Ground Level Tank Painter Journeyman	\$12.94
Ground Level Tank Painter Helper	\$5.17

Section 00800

EXHIBIT B – WORKER’S COMPENSATION INSURANCE COVERAGE

To: City of Tomball Contract Insurance Requirements
From: Mark A. McClure, P.E.
Director of Engineering & Planning
City of Tomball
Re: Certificate of Insurance Explanations

Effective immediately, to facilitate the processing of Contracts, the Engineering & Planning Department is requesting the following information to be submitted with each Certificate of Insurance. A sample Insurance form is attached, matching the numbered listings below:

1. Certificate must not be more than 12 months old.
2. Name and address of producer writing coverage.
3. Name of insurance company providing coverage as listed in Best’s Key Rating guide or on company’s Certificate of Authority on file with Texas Department of Insurance. Company must have rating of B+ or better; provided, however, that this requirement will be waived for workers compensation coverage if the coverage is placed with a company that participates in the State of Texas Workers’ Compensation Assigned Risk Pool.
4. Name and address of insured, as shown on policy.
5. Must reference the insurer of the policy being described.
6. Must be a policy number, no binders.
7. Date policy became effective.
8. Expiration date must be at least 60 days from date of delivery of certificate.
9. Check limits of liability against contract.
10. Must check either; 1) Any Auto, or 2) All Owned, Hired, and Non-Owned Autos.
11. Statutory limits must be checked per our ordinance.
12. Must name the City as Additional Insured on Commercial General Liability and Automobile Liability. Must have a Waiver of Subrogation in favor of the City on Commercial General Liability, Automobile Liability, and Workers’ Compensation/Employers’ Liability.
13. Name and file number of project.
14. Address of the City of Tomball and the name of the project manager (as a suggestion either project applicable Department Director or Assistant City Manager).
15. Cancellation clause of the underlying policy must be endorsed to provide that “should any of the above described policies be canceled before the expiration date thereof, the issuing company will mail 30 days written notice to the certificate holder named.”
16. Signature or facsimile signature of authorized representative of producer.

UNLESS OTHERWISE SPECIFIED:

Minimum Insurance Requirements: Small contracts (less than \$50,000.00) – Workers’ Compensation Insurance and Automobile Liability Insurance required by law.

Minimum Insurance Requirements:

All other contracts

1. Commercial General Liability: \$500,000 per occurrence for bodily injury, personal injury and property damage, \$1,000,000 Aggregate Policy will include coverage for
 - a) Premises – Operations;
 - b) Broad Form Contractual Liability;
 - c) Products and Completed Operations;
 - d) Use of contractors and Subcontractors;
 - e) Personal Injury;
 - f) Broad Form Property Damage;
 - g) Explosion Collapse and Underground (XCU) Coverage (when applicable), Fire Damage, Medical Expense.

NOTE: The aggregate loss limit applies to each project.

2. Workers’ Compensation and Employer’s Liability: Workers’ Compensation limits as required by the Labor Code of the State of Texas and Statutory Employer’s Liability Limits.
3. Automobile Liability - \$500,000 per occurrence; \$1,000,000 Aggregate if contract involves road construction projects.

CERTIFICATE OF INSURANCE		ISSUE DATE: ①			
PRODUCER: ②		COMPANIES AFFORDING COVERAGE: ③			
		Company Letter A			
		Company Letter B			
INSURED: ④		Company Letter C			
		Company Letter D			
		Company Letter E			
COVERAGES THIS IS TO CERTIFY THAT THE POLICES 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 COMPANIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.					
CO LTR: ⑤	TYPE OF INSURANCE	POLICY NUMBER: ⑥	POLICY EFFECTIVE DATE (MM/DD/YY): ⑦	POLICY # & EXPIRATION DATE (MM/DD/YY): ⑧	LIMITS: ⑨
	GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS MADE <input checked="" type="checkbox"/> OCCURRENCE				GENERAL AGGREGATE \$ PRODUCTS-COMP/OP AGG \$ PERSONAL & ADV. INJURY \$ EACH OCCURRENCE \$ FIRE DAMAGE (Any one fire) \$ MED. EXPENSE (Any one person) \$
	AUTOMOBILE LIABILITY ⑩ <input type="checkbox"/> ANY AUTO <input checked="" type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS <input type="checkbox"/> GARAGE LIABILITY				COMBINED SINGLE LIMIT \$ BODILY INJURY (PER PERSON) \$ BODILY INJURY (PER ACCIDENT) \$ PROPERTY DAMAGE \$
	WORKERS COMPENSATION AND EMPLOYERS LIABILITY <input checked="" type="checkbox"/> INCL THE PROPRIETOR/PARTNERS/EXECUTIVE OFFICERS ARE: _____ EXOL				<input checked="" type="checkbox"/> STATUTORY LIMITS ⑪ EACH ACCIDENT DISEASE - POLICY LIMIT \$ DISEASE - EMPLOYEE \$
	OTHER PROFESSIONAL LIABILITY				Per Claim Aggregate \$
DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / SPECIAL ITEMS: ⑫ GENERAL LIABILITY AND AUTOMOBILE LIABILITY POLICIES ENDORSED TO INCLUDE CITY OF TOMBALL AS ADDITIONAL INSURED WAIVER OF SUBROGATION GRANTED TO CITY OF TOMBALL WITH RESPECT TO AUTOMOBILE LIABILITY, WORKERS' COMPENSATION AND GENERAL LIABILITY					
PROJECT DESCRIPTION: ⑬					
CERTIFICATE HOLDER: ⑭ CITY OF TOMBALL			CANCELLATION: ⑮		
DEPARTMENT OF: _____ NAME: _____ Tomball, Texas 77315			SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELED, NON-RENEWED OR MATERIALLY CHANGED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT.		
AUTHORIZED REPRESENTATIVE: ⑯					

Section 00800

ATTACHMENT C

A Listing of the Duties, Responsibilities, and Limitations to Authority of the
Resident Project Representative (RPR)

A. General

RPR as Owner's agent at the site, will act as directed by and under the supervision of the Owner, and will confer with Engineer regarding RPR's actions. RPR's dealings in matters pertaining to the on-site Work shall in general be with ENGINEER and CONTRACTOR keeping OWNER advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of CONTRACTOR. RPR shall generally communicate with OWNER with the knowledge of and under the direction of ENGINEER.

B. Duties and Responsibilities of RPR

1. Schedules:

Review the progress schedule, schedule of Shop Drawing submittals, and other required schedules prepared by CONTRACTOR and consult with ENGINEER concerning acceptability.

2. Conferences and Meetings:

Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences, and other project-related meetings, and prepare and circulate copies of minutes thereof.

3. Liaison:

- a. Serve as ENGINEER's Liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent, and assist in understanding of the Contract Documents, and assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-site operations.
- b. Assist in obtaining from OWNER additional details or information when required for proper execution of the Work.

4. Shop Drawings and Samples:

- a. Record date of receipt of Shop Drawings and samples.
- b. Receive samples, which are furnished at the site by CONTRACTOR, and notify ENGINEER of availability of samples for examination.

- c. Advise ENGINEER and CONTRACTOR of the commencement of any Work requiring a Shop Drawing or sample if the submittal has not been approved by ENGINEER.

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

- a. Conduct on-site observations of the Work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.
- b. Report to ENGINEER whenever RPR believes that any Work is unsatisfactory, faulty or defective, or does not conform to the Contract Documents, or has been damaged or does not meet the requirements of any inspection, test, or approval required to be made; and advise ENGINEER of Work that RPR believes should be corrected or rejected, or should be uncovered for observation, or requires special testing, inspection, or approval.
- c. Verify that tests, equipment and systems start-up and operating and maintenance training are conducted in the presence of appropriate personnel, and that CONTRACTOR maintains adequate records thereof; and observe, record, and report to ENGINEER appropriate details relative to the test procedures and start-ups.
- d. Accompany visiting inspectors, other than the OWNER's, representing public or other agencies having jurisdiction over the Project, record the result of these inspections, and report to ENGINEER.

6. Interpretation of contract Documents:

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

7. Modifications:

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

8. Records:

- a. Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the contract, ENGINEER's clarification and interpretations of the contract Documents, progress reports, and other Project-related documents.
- b. Keep a diary or log book recording CONTRACTOR hours on the job site, weather conditions, data relative to questions of Work Directive Changes, Change Orders or

changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures, and send copies to ENGINEER.

- c. Record names, addresses, and telephone numbers of all contractors, subcontractors, and major Suppliers of materials and equipment.

9. Reports:

- a. Furnish ENGINEER periodic reports as required of progress of the Work and of CONTRACTOR's compliance with the progress schedule and schedule of Shop Drawings and sample submittals.
- b. Consult with ENGINEER in advance of schedule of major tests, inspections, or start of important phases of the Work.
- c. Draft proposed Change Orders and Work Directive Changes, obtaining Back-up material from Contractor, and recommend to ENGINEER Change Orders, Work Directive Changes, and Field Orders.
- d. Report immediately to OWNER and ENGINEER upon the occurrence of any accident.

10. Payment Requests:

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

11. Certificates, Maintenance and Operation Manuals:

During the course of the Work, verify that certificates, maintenance and operation manuals, and other data required to be assembled and furnished by CONTRACTOR are applicable to the items actually installed and in accordance with the Contract documents, and have this material delivered to ENGINEER for review and forwarding to OWNER prior to final payment for Work.

12. Completion:

- a. Before ENGINEER issues a Certificate of Substantial Completion, submit to CONTRACTOR a list of observed items requiring completion of correction.
- b. Conduct final inspection in the company of ENGINEER, OWNER, and CONTRACTOR, and prepare a final list of items to be completed or corrected.
- c. Observe that all items on final list have been completed or corrected and make

recommendations to ENGINEER concerning acceptance.

C. Limitations of Authority

Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment unless authorized by ENGINEER.
2. Shall not exceed limitations of authority as set forth in the Agreement or the Contract Documents.
3. Shall not undertake any of the responsibilities of CONTRACTOR, subcontractor, or CONTRACTOR's superintendent.
4. Shall not advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction unless such advice or directions are specifically required by the Contract Documents.
5. Shall not advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.
6. Shall not accept Shop Drawing or sample submittals from anyone other than CONTRACTOR.
7. Shall not authorize OWNER to occupy the Project in whole or in part.
8. Shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Owner.

Section 00800

EXHIBIT E – CHANGE ORDER FORM

Document 00941

CHANGE ORDER / C.O. No. _____

PROJECT:
CONTRACT No.: _____ PROJECT No.: _____

TO: _____
Contractor and _____
Address for Written Notice _____

REFERENCE RFIs/RFPs:

1.01 DESCRIPTION OF CHANGES

	CONTRACT CHANGE	
	AMOUNT	TIME
ITEM 1 SCOPE: [Description of first change order item] JUSTIFICATION: [Justification for adding or deleting work described in "Item 1 Scope"]	\$0.00	0 Days
ITEM 2 SCOPE: JUSTIFICATION:	\$0.00	0 Days
ITEM 3 SCOPE: JUSTIFICATION:	\$0.00	6 Days
TOTALS:	\$0.00	6 Days

1.02 ACCEPTANCE BY CONTRACTOR

Contractor agrees to perform change(s) included in this Change Order for the price and time indicated. The prices for changes include all costs associated with this Change Order.

Contractor Signature and Title

Date

1.03 ACCEPTANCE BY THE CITY

Project Manager Date

[Director – Required for COs to Council] Date

[Intermediate Authority, if needed] Date

[Mayor – Required for COs to Council] Date

[Intermediate Authority, if needed] Date

City Engineer Date

END OF DOCUMENT

cc: [Design Consultant], [Owning Dept. Director], [Other Copy Addrees], [File(s)]

EXECUTIVE SUMMARY

C.O. No. _____ Contract No.: _____ Proj. No.: [File No.]

1.01	CONTRACT PRICE SUMMARY	DOLLAR AMOUNT	PERCENT
A.	Original Contract Price	\$1,000,000.00	100.00%
B.	Previous Change Orders	\$0.00	0.00%
C.	This Change Order	\$0.00	0.00%
D.	Contract Price	\$1,000,000.00	100.00%

Date of Commencement of the Work: Monday, September 30, 2002

1.02	CONTRACT TIME SUMMARY	DURATION	COMPLETION DATE
A.	Original Contract Time	180 Days	Friday, March 28, 2003
B.	Previous Change Orders	0 Days	Friday, March 28, 2003
C.	This Change Order	0 Days	
D.	Contract Time	180 Days	Friday, March 28, 2003

1.03 TOTAL VALUE OF INCREASES OUTSIDE OF GENERAL SCOPE OF WORK

A. Including this Change Order, the following table is provided to track conditions related to Paragraph 7.1.2.3 of Document 00700 - General Conditions.

<u>CHANGE ORDER No.</u>	<u>AMOUNT ADDED</u>	<u>PERCENT OF ORIGINAL CONTRACT PRICE</u>
[1]	[\$0.00]	[0%]
TOTALS	\$0.00	0.0%

END OF SUMMARY INSTRUCTIONS

PURPOSE: Change Orders are used to affect Modifications to the Contract. Prior to final payment, previously approved Work Change Directives can be combined into a summary Change Order to reconcile project cost accounting. When signed and dated by Contractor and City Engineer, document becomes an approved Change Order.

APPLICATION: This form is applicable to agreed on Modifications to the Contract including, but not limited to the following:

- . Additions or reductions (including deletions) of existing bid item quantities.
- . Increases or decreases in construction Contract Time.
- . Change in methods, material, etc., not covered by existing bid item quantities.
- . New work not covered by existing bid item quantities.
- . Price or schedule consideration for conditions not indicated by the Contract.

INSTRUCTIONS: Project Manager or Design Consultant prepares this form. The Executive Summary is for use by the City in analyzing the Change Order but is not a part of the Change Order. This form has two MS Excel tables imbedded in the MS Word document (Paragraphs 1.01 and 1.02 in the Executive Summary). Double click on any cell in these tables to make entries in spreadsheet mode. Click anywhere outside the spreadsheet to return to wordprocessing mode. Other tables in the Change Order and Executive Summary are MS Word tables, not imbedded Excel spreadsheets. Red colored text and numerals represent input fields. Black text and numerals are in cells with formulas or fixed text. Do not make entries in these cells. Following instructions correspond to blanks requiring input and paragraph numbers on form. Paragraph 1.02 of the Change Order form is completed by Contractor. All other items are completed by the City or Design Consultant. Paragraph 1.03 of the Change Order form is completed by administrative and approving authorities. Contractor shall provide all backup material to justify the costs of items enumerated in Paragraph 1.01 of the Change Order form.

CHANGE ORDER FORM:

1. Insert Change Order number and Contract number for the Project at the top of each page, following page one, if the Change Order must be longer than one page.
2. Insert Project name exactly as stated in the Agreement.
3. Insert Project number and other identifying numbers (e.g. CIP, Proj. No., AIP, File No.) for the Project.
4. Insert name of Contractor performing the Work and Contractor's address for notices. Address should be as shown in the Agreement unless changed by proper notice.
5. Insert applicable references to related RFIs and RFPs.
6. Paragraph 1.01: Insert brief descriptions of the changes, including reference to applicable Work Change Directives. Give justification to support change, cost of making change, and adjustment in Contract Time warranted by change. If more than one item is included, number each item. Extend the table to additional pages if necessary. Formulas are imbedded for totals but check the math when extending the table length.
7. Paragraph 1.02: Project Manager signs and dates and has other administrative authorities or representatives sign and date where indicated. Project Manager will substitute actual titles of these persons where red bracketed instructions are shown. Mayor's and Contracting Department Director's signature (and date) are only needed when the Change Order must go to City Council for funding prior to approval. City Engineer for Contracting Department (should be the same person designated in the Agreement) will only sign and date Paragraph 1.03 when funds are approved and in place for payment of additional work. City Engineer's signature and date signify approval of Change Order and is the only authorized approval authority of the City according to Document 00700 – General Conditions.
8. Insert appropriate list of "copy to" persons and file. Delete brackets and instructions. Change color of remaining text to black.

EXECUTIVE SUMMARY:

1. Paragraph 1.01: Insert (A) Original Contract Price, (B) cost of previous Change Orders and (C) cost of this Change Order in the price summary block. Other amounts and percentages in block are calculated by formula. Cost of this Change Order is calculated at the bottom of the table in Paragraph 1.01 of the Change Order form, when all items have been filled in BUT it does not automatically change the amount in Paragraph 1.01 C.
2. Paragraph 1.02: Insert Date of Commencement of Work (from Notice to Proceed), (A) original Contract Time, (B) additional days added from previous Change Orders and (C) days required for this Change Order in the time summary block. Other days and dates in block are calculated by formula. Days for this Change Order are calculated at the bottom of the table in Paragraph 1.01 of the Change Order form, when all items have been filled in BUT it does not automatically change the amount in Paragraph 1.02 C.
3. Paragraph 1.03 A: Project Manager will provide information from all previous Change Orders for this table (i.e. number, amount and percentage of Original Contract Price) so that it can be determined if Council Action is necessary. *NOTE: The conditions of Paragraph 7.1.2.3 of Document 00700 - General Conditions may make Council Action necessary even if funding is already available and even if the 5% contingency threshold has not yet been reached.*

Section 00800

EXHIBIT F - ESTIMATE AND CERTIFICATE FOR PAYMENT, UNIT PRICE WORK
 Document 00643 (sample form)
 (Contractor required to submit final form utilized for approval)

Project Name: _____ Estimate No. _____
 Contractor: [Contractor's Company Name] _____ Cut off Date: _____
 Address: [Contractor's Company Address] _____ Estimate Date: _____
 Contract No.: [Contract Number] _____
 Project No.: _____
 Ordinance No.: [Contract Ordinance Number] _____

Contract Date: _____
 Start Date: _____
 Current Contract Completion Date: _____
 Substantial Completion Date: _____
 Percentage: By Time 0.00% In Place 0.00%

CONTRACT TIME IN CALENDER DAYS
 Original Contract Time: _____ Days
 Approved Extensions: _____ Days
 Total Contract Time: _____ Days
 Days Used to Date: _____ Days
 Days Remaining to Date: _____ Days

Date Insurance Exp. _____ Drug Policy Due _____
 Current _____ Schedule Update Received _____

CONTRACT AMOUNT TO DATE:

1. Original Contract Price:		\$0.00
2. Approved Change Orders: No./Description	<u>Amount</u>	
_____	\$0.00	
_____	\$0.00	
_____	\$0.00	
_____	\$0.00	
_____	\$0.00	
_____	\$0.00	
Total Change Orders to Date: +/-	\$0.00	\$0.00
TOTAL CONTRACT AMOUNT:		<u>\$0.00</u>

A. EARNINGS TO DATE:

1. Work Completed to Date: <u>0.00%</u> Complete	\$0.00	
2. Materials Stored on Site: _____	\$0.00	
3. Materials Stored in Place: _____	\$0.00	
4. Balance - Materials Accepted, Not in Work: _____	\$0.00	
TOTAL EARNINGS TO DATE:		<u>\$0.00</u>

B. DEDUCTIONS:

1. Retainage: <u>0.00%</u> of <u>\$0.00</u>	\$0.00	
2. Add: Retainage Deduction: _____	\$0.00	
3. Total Retainage: _____	\$0.00	
4. Liquidated Damages: _____ Days @ _____	\$0.00	
5. Quality Control Retest Cost: _____	\$0.00	
6. Sunday/Holiday Overtime Cost: _____	\$0.00	
TOTAL DEDUCTIONS:		<u>\$0.00</u>

C. AMOUNT DUE THIS PERIOD:

1. Total Earnings to Date:	\$0.00	
2. Total Deductions:	\$0.00	
3. Total Payments Due:		\$0.00
4. Less Previous Payments:		\$0.00
5. Restoration Adjustment:		\$0.00
TOTAL AMOUNT DUE THIS DATE:		<u>\$0.00</u>

Prepared By: _____ Date: _____ Checked By: _____ Date: _____
 Submitted By: _____ Date: _____ Approved: _____ Date: _____
 Approved: _____ Date: _____
 Director, [Contracting Department]

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 construction of Water Supply and Storage Facility No. 5 for the City of Tomball, Texas. The Work includes, but is not limited to:
1. 1,500 gpm water well,
 2. 500,000 gallon welded steel ground storage tank,
 3. 5,000 hydropneumatic tank,
 4. Three 1,000 gpm split case centrifugal booster pumps on a concrete pad,
 5. Masonry block motor control center with electrical equipment,
 6. Chlorine gas disinfection system,
 7. 800 kW emergency power natural gas generator,
 8. Offsite 16-inch waterline, 2-inch forcemain, and 2-inch natural gas main.
 9. Included in the alternate bid items are a 500,000 gallon glass lined ground storage tank, a liquid phosphate system, and a 750 kW emergency power diesel generator.

1.03 WORK SEQUENCE

- A. Construction shall be achieved in two phases. Phase I shall have a milestone of 35 days for completion. Substantial completion for the entire project shall be 300 days, with Final completion at 330 days. Items of Work for each phase are as follows:

Phase I – Drilling water well pilot hole, performing pilot hole tests, and submitting analysis to the Engineer

Phase II – Completion of water well; construction of ground storage tank; hydropneumatic tank; MCC building; electrical components; disinfection system(s); emergency power generator; lift station; yard piping; offsite waterline, forcemain and gas main; drainage; grading; paving; fence; and all other items required by the contract documents.

No work shall proceed on any components of the water plant, other than the well, until it is determined that the well will produce acceptable water in accordance with the specifications. This determination will be made by the Engineer.

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 review his proposed haul routes with the City and shall only utilize those routes deemed acceptable by the City. The City shall not unreasonably withhold acceptance of a route. Routes will be evaluated for traffic, pavement condition, and public nuisance.
- C. 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.
- D. The CONTRACTOR shall sequence all work such that at least one lane is open to traffic in all public streets at all times. 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.
- E. On the streets that are too narrow to maintain at least one lane of traffic during construction activities, CONTRACTOR may close a maximum of two (2)

consecutive blocks for up to eight (8) hours. CONTRACTOR shall provide detours to vehicular and pedestrian traffic when necessary.

- F. 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.
- G. 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.
- H. 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. Provide for the necessary temporary water source and pay for this service during the construction work.
- D. Provide adequate temporary sanitary facilities that are located at least 150 feet away from the proposed water well.
- 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.

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 requirements of the Specification section 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.

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 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 Samples
 - 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.
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.

- 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

1.1 SECTION INCLUDES

1. Methods, schedule, and process to be followed for shop drawings, product data and sample submittals.

1.2 REQUIREMENT

1. 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 01300 - Submittal Procedures and the requirements of this Section.
2. Shop drawings, product data and samples are not considered Contract Documents.

1.3 SHOP DRAWING/SUBMITTAL SCHEDULE

1. 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.

1.4 SHOP DRAWINGS

1. Submit shop drawings for review as required by the Specifications. Have shop drawings reviewed and signed by a registered professional.
2. Place Contractor's Stamp on each drawing as described in Section 01300 - Submittal Procedures.
3. 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.
4. Make drawings to scale providing a true representation of the specific equipment or item to be furnished.

1.5 PRODUCT DATA

1. Submit product data for review as required in Specification sections.
2. Place Contractor's Stamp, on each data item submitted, as described in Section 01300 - Submittal Procedures.
3. 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.
4. For products specified only by reference standard, give manufacturers, trade name, model or catalog designation and applicable reference standard.
5. Preapproved and Prequalified Products.
 1. For "preapproved", "prequalified" and "approved" products named in City standard products list, provide appropriate list designation as described in Section 01630 - Product Substitution Procedures within 30 days after Notice to Proceed.
 2. For products proposed as alternates to "approved" products, provide information required to demonstrate the proposed products meet the level of quality and performance criteria of the "approved product".

1.6 SAMPLES

1. Submit samples for review as required by the Specifications. Have samples reviewed and signed by a registered professional.
2. Place Contractor's Stamp on each sample or a firmly attached sheet of paper, as described in Section 01300 - Submittal Procedures.
3. Submit the number of samples specified in Specifications; one of which will be retained by the City Engineer.
4. Reviewed samples which may be used in the Work are identified in Specifications.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

Section 01410

TPDES REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Documentation to be prepared and signed by CONTRACTOR before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 issued March 5, 2003 (the Construction General Permit).
- B. Implementation, maintenance, inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other practices shown on the Drawings or specified elsewhere in this or other Specifications.
- C. Review of the Storm Water Pollution Prevention Plan (SWPPP) implementation in a meeting with the ENGINEER prior to start of construction.

1.02 DEFINITIONS

- A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.
- B. Large Construction Activity: Project that:
 - 1. Disturbs five acres or more, or
 - 2. Disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.
- C. Small Construction Activity: Project that:
 - 1. Disturbs one or more acres but less than five acres, or
 - 2. Disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.
- D. TPDES Operator:
 - 1. The person or persons who have day-to-day operational control of the construction activities, which are necessary to ensure compliance with the SWPPP for the site or other Construction General Permit conditions.

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 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

- A. Prepare a SWPPP following Part III of the Construction General Permit.
- B. Update or revise the SWPPP as needed during the construction following Part III, Section E of the Construction General Permit.
- C. Submit the SWPPP and any updates or revisions to ENGINEER for review and address comments prior to commencing, or continuing construction activities.

3.02 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

- A. Fill out, sign, and date TCEQ Form 20022 (02/03) Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000), Attachment 1 of this Section 01410.
- B. Transmit the signed Contractor's copy of TCEQ Form 20022 (02/03), along with a \$100.00 check, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to ENGINEER.
- C. ENGINEER will complete a separate TCEQ Form 20022 (02/03) for City's Notice of Intent, and will submit both Notices, along with checks for application fees, to the TCEQ.
- D. Submission of the Notice of Intent form by both the City and Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

3.03 NOTICE OF INTENT FOR SMALL CONSTRUCTION ACTIVITY

- A. Fill out, sign, and date Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice", Attachment 2 of this Section 01410.
- B. Transmit the signed Construction Site Notice to ENGINEER at least seven days prior to Commencement of Construction Activity.

3.04 CERTIFICATION REQUIREMENTS

- A. Submit Contractor's name, address, and telephone number, and the names of persons or firms responsible for maintenance and inspection of erosion and sediment control measures.
- B. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures

read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form, Attachment 3 of this Section 01410.

3.05 RETENTION OF RECORDS

- A. Keep a copy of this document and the SWPPP in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SWPPP implementation shall have a copy of the SWPPP available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWPPP. Upon submission of the NOT, submit all required forms and a copy of the SWPPP with all revisions to ENGINEER.

3.06 REQUIRED NOTICES

- A. Post the following notices from the effective date of the SWPPP until date of final site stabilization as defined in the Construction General Permit:
1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. Signed copies of the City's and Contractor's NOI must also be posted.
 2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description, and location of the SWPPP.
 - a. If posting near a main entrance of the construction site is not feasible due to safety concerns, coordinate posting of notice with OWNER to conform to requirements of the Construction General Permit.
 - b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move as necessary.
 3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.
 4. Post a notice of waste disposal procedures in a readily visible location on site.

3.07 ON-SITE WASTE MATERIAL STORAGE

- A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.

- B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWPPP.
- C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWPPP.

3.08 NOTICE OF TERMINATION

- A. Submit a NOT, Attachment 4 of this Section 01410, to ENGINEER within 30 days after:
 - 1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
 - 2. Another operator has assumed control over all areas of the site that have not been stabilized; and
 - 3. All silt fences and other temporary erosion controls have either, been removed, scheduled to be removed as defined in the SWPPP, or transferred to a new operator if the new operator has sought permit coverage.
- B. ENGINEER will complete City's NOT and submit Contractor and City's notices to the TCEQ and MS4 entities.

END OF SECTION



**Notice of Intent (NOI) for Storm Water
Discharges Associated with Construction
Activity under TPDES General Permit
(TXR150000)**

TCEQ Office Use Only
Permit No.: TXR15
RN:
CN:
Ref No:



**Sign up now for ePermits NOI at www6.tceq.state.tx.us/steers
Get Instant Permit Coverage and only pay a \$225 application fee.**

If filing a paper NOI you can pay the application fee on line? Go to www.tceq.state.tx.us/epay
Select Fee Type: GENERAL PERMIT CONSTRUCTION STORM WATER DISCHARGE NOI APPLICATION
If submitting a paper NOI, coverage under the general permit starts seven (7) days after the date postmarked for delivery to TCEQ.

IMPORTANT:

- Use the **INSTRUCTIONS** to fill out each question in this form.
- Use the attached **CUSTOMER CHECKLIST** to make certain all you filled out all required information.
- Incomplete applications **WILL** delay approval or result in **automatic Denial**.

Renewal of General Permit

Is this NOI to renew an ACTIVE permit?

- Yes - What is your permit number? Permit No. TXR15 _____
 No - a permit number will be issued.

Application Fee if mailing a paper NOI:

You must pay the \$325 Application Fee to TCEQ for the application to be considered complete.
Payment and NOI must be mailed to separate addresses. See instructions for correct mailing addresses.

Provide your payment information below, for us to verify payment of the application fee:

<input type="checkbox"/> Mailed:	Check/Money Order No.:	Company Name on checking account:
<input type="checkbox"/> EPAY:	Voucher No.:	Is the Payment Voucher copy attached? <input type="checkbox"/> Yes

A. OPERATOR (applicant)

1. If the applicant is currently a customer with TCEQ, what is the Customer Number (CN) issued to this entity?
CN _____
(Search Central Registry)

2. What is the Legal Name of the entity (applicant) applying for this permit?

(The legal name must be spelled exactly as filed with the Texas Secretary of State, County, or in the legal document forming the entity.)

3. What is the name and title of the person signing the application?

(The person must be an official meeting signatory requirements in TAC 305.43(a).)

Name:	Job Title:
-------	------------

4. What is the Operator's (applicant) mailing address as recognized by the US Postal Service? (verify at USPS.com)

Address:	Suite No./Bldg. No./Mail Code:	
City:	State:	ZIP Code:
Country Mailing Information (if outside USA):	Country Code:	Postal Code:

5. Phone No.: () Extension:

6. Fax No.: () E-mail Address:

7. Indicate the type of Customer:

- | | | |
|---|---|--|
| <input type="checkbox"/> Individual | <input type="checkbox"/> Sole Proprietorship-D.B.A. | <input type="checkbox"/> Limited Partnership |
| <input type="checkbox"/> Corporation | <input type="checkbox"/> Federal Government | <input type="checkbox"/> General Partnership |
| <input type="checkbox"/> State Government | <input type="checkbox"/> County Government | <input type="checkbox"/> City Government |
| <input type="checkbox"/> Other Government | <input type="checkbox"/> Other (describe): | |

8. Independent Operator:		<input type="checkbox"/> Yes	<input type="checkbox"/> No (If governmental entity, subsidiary, or part of a larger corporation, check "No".)
9. Number of Employees:		<input type="checkbox"/> 0-20;	<input type="checkbox"/> 21-100; <input type="checkbox"/> 101-250; <input type="checkbox"/> 251-500; or <input type="checkbox"/> 501 or higher
10. Customer Business Tax and Filing Numbers <i>(This item is not applicable to Individuals, Government, GP or Sole Proprietor.)</i> REQUIRED for Corporations and Limited Partnerships (Verify the entity's status and filing no. with TX SOS at 512/463-5555)			
State Franchise Tax ID Number:		Federal Tax ID:	
TX SOS Charter (filing) Number:		DUNS Number (if known):	
B. APPLICATION CONTACT			
If TCEQ needs additional information regarding this application, who should be contacted?			
1. Name:	Title:		Company:
2. Phone No.: ()		Extension:	
3. Fax No.:		E-mail Address:	
C. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE			
1. TCEQ Issued RE Reference Number (RN): RN (Search Central Registry)			
2. Name of Project or Site (the name as known by the community where this facility/project is located): (example: phase and name of subdivision or name of project that's unique to the site)			
3. Does the site have a physical address? If Yes, complete Section A for a physical address. If No, complete Section B for site location information.			
Section A: Enter the physical address for the site. (verify it with USPS.com or other delivery source)			
Street Number:		Street Name:	
City:		ZIP Code:	
Section B: Enter the site location information.			
If no physical address (Street Number & Street Name), provide a written location access description to the site: (Ex.: phase 1 of Woodland subdivision located 2 miles west from intersection of Hwy 290 & IH35 accessible on Hwy 290 South)			
City where the site is located or nearest city to site:		ZIP Code where site is located:	
4. Identify the county where the site is located:			
5. Latitude:		Longitude:	
6. What is the primary business of this entity? In your own words, briefly describe the primary business of the Regulated Entity: (Do not repeat the SIC and NAICS code)			
7. What is the mailing address for the regulated entity?			
Is the RE mailing address the same as the Operator? <input type="checkbox"/> Yes, address is the same as Operator <input type="checkbox"/> No, provide the address			
Street Number:		Street Name:	
City:	State:		ZIP Code:
D. GENERAL CHARACTERISTICS			
1. Is the site located on Indian Country Lands? <input type="checkbox"/> No <input type="checkbox"/> Yes – If Yes, do not submit this NOI. Contact EPA, Region VI If the site is on Indian country lands, you must obtain authorization through EPA, Region VI.			
2. What is the Standard Industrial Classification (SIC) code (see instructions for common codes): (Search Osha.gov)			
Primary: _____		Secondary: _____	

3(a) What is the total number of acres disturbed? _____

3(b) Is the project site part of a larger common plan of development or sale? Yes No

If Yes, the total number of acres disturbed can be less than 5 acres.

If No, the total number of acres disturbed must be 5 or more. If the total number of acres disturbed is less than 5 then the project site does not qualify for coverage through this Notice of Intent. Coverage will be denied. See the requirements in the general permit for small construction sites.

4. Discharge Information (all information MUST be provided or the permit will be denied)

4(a) What is the name of the water body(s) to receive the storm water runoff or potential runoff from the site?

4(b) What is the segment number(s) of the classified water body(s) that the discharge or potential discharge will eventually reach?

4(c) Are any of the surface water bodies receiving discharges from the construction site on the latest EPA-approved CWA 303(d) list of impaired waters?

Yes No

If Yes, provide the name of the impaired water body(s). _____

4(d) Is the discharge into an MS4? Yes No

If Yes, what is the name of the MS4 Operator? _____

Note: The general permit requires you to send a copy of the NOI to the MS4 Operator.

4(e) Is the discharge or potential discharge within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer?

Yes No

If the answer is Yes, please note that a copy of the agency approved Plan required by the Edwards Aquifer Rule (30 TAC Chapter 213) must be included or referenced in the Storm Water Pollution Prevention Plan.

E. CERTIFICATION

Check "Yes" to the certifications below. **Failure to certify to all items will result in denial.**

- | | |
|------------------------------|---|
| <input type="checkbox"/> Yes | I certify that I have obtained a copy and understand the terms and conditions of the <u>general permit (TXR150000)</u> . |
| <input type="checkbox"/> Yes | I certify that the full legal name of the entity (Operator) applying for this permit has been provided and is legally authorized to do business in Texas. |
| <input type="checkbox"/> Yes | I understand that a Notice of Termination (NOT) must be submitted when this authorization is no longer needed. |
| <input type="checkbox"/> Yes | I certify that a storm water pollution prevention plan has been developed and will be implemented prior to construction, and that is compliant with any applicable local sediment and erosion control plans, as required in the general permit TXR150000. |

Operator Certification:

I, _____
Typed or printed name (Required & must be legible) _____
Title (Required & legible)

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I further certify that I am authorized under 30 Texas Administrative Code §305.44 to sign and submit this document, and can provide documentation in proof of such authorization upon request.

Signature: _____ Date: _____
(Use blue ink)

Did you complete everything? Use this checklist to be sure!

Are you ready to mail your form to TCEQ? Go to the General Information Section of the Instructions for mailing addresses.

Customer GP Notice of Intent Checklist TXR150000	
<input checked="" type="checkbox"/>	This checklist is for use by the operator to ensure a complete application. Missing information may result in denial of coverage under the permit. (See NOI Process description in the Instructions)
<input type="checkbox"/>	Application Fee of \$325.00 was mailed separately to TCEQ's Cashiers's Office (separate from the NOI) or the EPAY payment voucher is attached.
OPERATOR INFORMATION - Confirm each item is complete:	
√	
<input type="checkbox"/>	Customer Number (CN) issued by TCEQ Central Registry
<input type="checkbox"/>	Legal Name as filed to do business in Texas (Call TX SOS 512/463-5555)
<input type="checkbox"/>	Name and Title of person signing the application. This person must meet signatory requirements in 30 TAC Section 305.43
<input type="checkbox"/>	Operator Mailing Address is complete & verifiable with USPS. www.usps.com
<input type="checkbox"/>	Phone Numbers/E-mail Address
<input type="checkbox"/>	Type of Operator (Entity Type)
<input type="checkbox"/>	Independent Operator
<input type="checkbox"/>	Number of Employees
<input type="checkbox"/>	For Corporations or Limited Partnerships -- Tax ID and SOS Filing numbers are REQUIRED
Application Contact person we can call for questions about this application.	
REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE - Confirm each item is complete:	
√	
<input type="checkbox"/>	Regulated Entity Reference Number (RN) (if site is already regulated by TCEQ)
<input type="checkbox"/>	Site/Project Name/Regulated Entity
<input type="checkbox"/>	Site/Project (RE) Physical Address Please do not use a rural route or post office box for a site location
<input type="checkbox"/>	Or if no physical address, the location information that includes description, zip code and city is listed.
<input type="checkbox"/>	Latitude and Longitude TCEQ USGS Topographic Map Viewer or TerraServer-USA
<input type="checkbox"/>	Business description
<input type="checkbox"/>	Site Mailing Address (checked same as operator or complete & verifiable with USPS. www.usps.com)
GENERAL CHARACTERISTICS - Confirm each item is complete:	
√	
<input type="checkbox"/>	Indian Country Lands –the facility is not on Indian Country Lands
<input type="checkbox"/>	Standard Industrial Classification (SIC) code www.osha.gov/oshstats/sicser.html
<input type="checkbox"/>	Acres Disturbed is provided and qualifies for coverage through a NOI.
<input type="checkbox"/>	Common plan of development or for sale?
Discharge Information:	
<input type="checkbox"/>	receiving water body
<input type="checkbox"/>	segment number(s) is REQUIRED
<input type="checkbox"/>	water body on the latest EPA-Approved Clean Water Act 303(d) list of impaired waters
<input type="checkbox"/>	MS4 Operator
<input type="checkbox"/>	Edwards Aquifer Rule
CERTIFICATION	
<input type="checkbox"/>	Certification statements have been checked indicating "Yes" Signature meets 30 Texas Administrative Code (TAC) §305.44 and is original and has been provided for the Operator.

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under TPDES General Permit (TXR150000) General Information and Instructions

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI) and other related forms:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
P.O. Box 13087
Austin, TX 78711-3087

BY OVERNIGHT/EXPRESS MAIL

Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
12100 Park 35 Circle
Austin, TX 78753

TCEQ Contact list:

Application Processing Questions relating to the status and form requirements:	512/239-3700, 512/245-0130 or swpermit@tceq.state.tx.us
Technical Questions relating to the general permit:	512/239-4671 or swgp@tceq.state.tx.us
Environmental Law Division:	512/239-0600
Records Management for obtaining copies of forms submitted to TCEQ:	512/239-0900
Information Services for obtaining reports from program data bases (as available):	512/239-DATA (3282)
Financial Administration's Cashier's office:	512/239-0357 or 512/239-0187

Notice of Intent Process:

When your NOI is received by the program, the form will be processed as follows:

1. **Administrative Review:** Each item on the form will be reviewed for a complete response. In addition, the operator's legal name must be verified with Texas Secretary of State as valid and active (if applicable). The address(s) on the form must be verified with the US Postal service as an address receiving regular mail delivery. Never give an overnight/express mailing address.

2. **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a notice of deficiency (NOD) will be mailed to the operator. The operator will have 30 days to respond to the NOD. The response will be reviewed for completeness.

3. **Acknowledgment of Coverage:** An Acknowledgment Certificate will be mailed to the operator. This certificate acknowledges coverage under the general permit.

-or-

Denial of Coverage: If the application is too incomplete to process, or the operator fails to respond to the NOD or the response is inadequate, coverage under the general permit may be denied. If coverage is denied, the operator will be notified.

General Permit (Your Permit)

If filing the NOI through ePermits online application, coverage under the general permit begins the day the NOI is submitted to TCEQ through epermits. **Sign up now for on line NOI at <https://www6.tceq.state.tx.us/steers/>**

If mailing a paper NOI, coverage under the general permit begins **seven (7) days after a completed NOI is postmarked for delivery to the TCEQ.** You should have a copy of your general permit when submitting your application.

You may view and print your permit for which you are seeking coverage, on the TCEQ web site http://www.tceq.state.tx.us/permitting/water_quality/stormwater/TXR15_AIR.html.

General Permit Forms

The Notice of Intent (NOI), Notice of Termination (NOT), and Notice of Change (NOC) #20391 with instructions are available in Adobe Acrobat PDF format on the TCEQ web site http://www.tceq.state.tx.us/permitting/water_quality/stormwater/TXR15_AIR.html.

Sign up now for on line Notice of Termination application at <https://www6.tceq.state.tx.us/steers/>

Change in Operator

An authorization under the general permit is not transferable. If the operator or owner of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

TCEQ Central Registry Core Data Form

The Core Data Form has been incorporated into this form. **Do not send a core data form to TCEQ.**

After final acknowledgment of coverage under the general permit, the program will assign a Customer Number (CN) and Regulated Entity Number (RN). For Construction Permits, a new RN will be assigned for each Notice of Intent filed with TCEQ, since construction project sites can overlap with other Customers. The RN assigned to your construction project will not be assigned to any other TCEQ authorization.

You can find the information on the Central Registry web site at www4.tceq.state.tx.us/crpub. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID". Capitalize all letters in the permit number.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Application Fees:

\$225.00 application fee if submitting the NOI through ePermits.

\$325.00 application fee if submitting a paper NOI for processing.

The application fee is required to be paid at the time the NOI is submitted. Failure to submit payment at the time the application is filed will cause delays in acknowledgment or denial of coverage under the general permit.

• **Mailed Payments:**

DO NOT mail your check with the original Notice of Intent application.

Use the attached Application Fee payment submittal form if mailing the payment. Do not include a copy of the NOI.

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL

Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

• **ePAY Electronic Payment:**

Go to www.tceq.state.tx.us/epay

Select Water Quality, then select the fee category "GENERAL PERMIT CONSTRUCTION STORM WATER DISCHARGE NOI APPLICATION".

You must include a copy of the payment voucher with your NOI. Your NOI will not be considered complete without the payment voucher.

The Annual Water Quality Fee has been consolidated into the Application Fee effective March 5, 2008. An annual fee will not be assessed and billed to operators on 9/1/2008. This does not relieve the operator of fees due for prior fiscal year assessments.

The operator will continue to receive an invoice for payment of any past due annual fee. A 5% penalty will be assessed if the payment is received by TCEQ after the due date. Annual fee assessments cannot be waived as long as the authorization under the general permit was active on September 1 of the FY billed.

INSTRUCTIONS FOR FILLING OUT THE NOI FORM

A. OPERATOR (As defined in the general permit.)

1. TCEQ Issued Customer Number (CN)

TCEQ's Central Registry will assign each customer a number that begins with "CN," followed by nine digits. **This is not a permit number**, registration number, or license number.

- If this customer has not been assigned a Customer Reference Number, leave the space for the Customer Reference Number blank.
- If this customer has already been assigned this number, enter the operator's Customer Reference Number in the space provided.

2. Legal Name

Provide the legal name of the facility operator, as authorized to do business in Texas. The name must be provided exactly as filed with the Texas Secretary of State (SOS), or on other legal documents forming the entity, that is filed in the county where doing business. You may contact the SOS at 512/463-5555, or go to <http://www.sos.state.tx.us/corp/contact.shtml> for more information related to filing in Texas. If filed in the county where doing business, provide a copy of the legal documents showing the legal name.

3. Name and Title of person signing the Notice of Intent application form. Signature meets 30 Texas Administrative Code (TAC) §305.44

4. Operator Mailing Address

Provide a complete mailing address for receiving mail from the TCEQ. The address must be verifiable with the US Postal Service at www.usps.com, for regular mail delivery (not overnight express mail). If you find that the address is not verifiable using the USPS web search, please indicate the address is used by the USPS for regular mail delivery.

5. Phone Number

This number should correspond to this customer's mailing address given earlier. Enter the area code and phone number here. Leave "Extension" blank if this customer's phone system lacks this feature.

6. Fax Number and E-mail Address

This number and E-mail address should correspond to operator's mailing address provided earlier. (Optional Information)

7. Type of Entity

Check only one box that identifies the type of entity. Use the descriptions below to identify the appropriate entity type:

Individual is a customer who has not established a business, but conducts an activity that needs to be regulated by the TCEQ.

Sole Proprietorship— D.B.A. is a customer that is owned by only one person and has not been incorporated. This business may:

- be under the person's name
- have its own name ("doing business as," or d.b.a.)
- have any number of employees

Partnership is a customer that is established as a partnership as defined by the Texas Secretary of State's Office.

Corporation the customer meets all of these conditions:

- is a legally incorporated entity under the laws of any state or country
- is recognized as a corporation by the Texas Secretary of State
- has proper operating authority to operate in Texas.

Government- Federal, state, county, or city government (as appropriate)
the customer is either an agency of one of these levels of government or the governmental body itself.

Other is Estate, Trust, etc.

the customer does not fit one of the above descriptions. Enter a short description of the type of customer in the blank provided.

8. Independent Operator

Check "No" if this customer is a subsidiary, part of a larger company, or is a governmental entity. Otherwise, check "Yes."

9. Number of Employees

Check one box to show the number of employees for this customer's entire company, at all locations. This is not necessarily the number of employees at the site named in the NOI.

10. State Franchise Tax ID Number

Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter this number here.

Federal Tax ID

All businesses, except for some small sole proprietors, individuals, or general partnerships should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Sole proprietors, individuals, or general partnerships do not need to provide a federal tax ID.

TX SOS Charter (filing) Number

Corporations and Limited Partnerships required to register with the Texas Secretary of State are issued a charter or filing number. You may obtain further information by calling SOS at 512/463-5555 <http://www.sos.state.tx.us/corp/contact.shtml>.

DUNS Number Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.
B. Application Contact Provide the name, title and communication information of the person that TCEQ can contact for additional information regarding this application. If the application is missing information and there is no contact person to call, the application may be denied.
C. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE
1. Regulated Entity Reference Number (RN) This is a number issued by TCEQ's Central Registry to sites (a location where a regulated activity occurs) regulated by TCEQ. This is not a permit number, registration number, or license number. <ul style="list-style-type: none"> • If this Regulated Entity has not been assigned a Regulated Entity Number, leave this space blank. • If this customer has been assigned this number, enter the operator's Regulated Entity Number.
2. Site/Project Name/Regulated Entity If the site is already regulated by TCEQ, use the same name as on the existing <u>Regulated Entity Reference Number (RN)</u> . If new, provide the name of the site as known by the public in the area where the site is located. The name you provide on this application will be used in the TCEQ Central Registry as the Regulated Entity.
3. Site/Project (RE) Physical Address Section A: Enter the complete physical address of where the site is located. This must be a street number and street name for a complete physical address. This address must be validated through US Postal Service or your local police (911 service) as a valid address. Please confirm this to be a complete and valid address. In some rural areas, new addresses are being assigned to replace rural route addresses. Please do not use a rural route or post office box for a site location. Section B: If a site does not have an actual physical address that includes a street number and street name, then provide a complete written location access description, and the zip code and city where the site is located. For example: "The site is located 2 miles west from intersection of Hwy 290 & IH35, located on the southwest corner of the Hwy 290 South bound lane." This includes authorizations for construction projects such as highways and subdivision.
4. Identify the County where the site is located. If the site covers more than one county, provide the county that is most affected by the authorized activity and list the additional county(s) as secondary.
5. Latitude and Longitude Enter the latitude and longitude of the site in either degrees, minutes, and seconds or decimal form. For help obtaining the latitude and longitude, go to: TCEQ USGS Topographic Map Viewer or TerraServer-USA
6. Description of Activity Regulated In your own words, briefly describe the primary business being conducted at the site. (A description specific to what you are doing that requires this authorization - Do not repeat the SIC Code(s).)
SITE MAILING ADDRESS Provide a complete mailing address to be used by TCEQ for receiving mail at the site. In most cases, the address is the same as the operator. If so, simply place a check mark in the box. If you provide a different address, please verify the address with USPS as instructed above for the operator address.
D. GENERAL CHARACTERISTICS
1. Indian Country Lands If your site is located on Indian Country Lands, the TCEQ does not have authority to process your application. You must obtain authorization through EPA, Region VI, Dallas. Do not submit this form to TCEQ. Indian Country means (1) all land within the limits of any American Indian reservation under the jurisdiction of the U.S. government, notwithstanding the issuance of any patent, and including rights-of-way running throughout the reservation; (2) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or outside the limits of a State; and (3) all Indian allotments, the Indian titles which have not been extinguished, including rights-of-way running through the same. Indian Tribe means any Indian Tribe, band, nation, or community recognized by the Secretary of the Interior and exercising substantial governmental duties and powers.
2. Standard Industrial Classification (SIC) code Provide the SIC code that best describes the construction activity being conducted at the site. Common SIC Codes related to construction activities include: 1521 Construction of Single Family Homes; 1522 Construction of Residential Bldgs. Other than Single Family Homes; 1541 Construction of Industrial Bldgs. and Warehouses; 1542 Construction of Non-residential Bldgs. other than Industrial Bldgs. and Warehouses; 1611 Highway & Street Construction, except Highway Construction; 1622 Bridge, Tunnel, & Elevated Highway Construction; 1623 Water, Sewer, Pipeline & Communications, and Power Line Construction. For help with SIC codes, go to: www.osha.gov/oshstats/sicser.html

3. Estimated Area of Land Disturbed

- 3(a). Provide the approximate number of acres that the construction site will disturb.
- 3(b). Indicate is the site is part of a common plan of development or for sale.

Construction activities that disturb less than one acre, unless they are part of a larger common plan that disturbs more than one acre, do not require permit coverage.

Construction activities that disturb between one and five acre, unless they are part of a common plan that disturbs five acres or more acres, do not require submission of an NOI. Therefore, the estimated area of land disturbed should not be less than five, unless the project is part of a larger common plan that disturbs five or more acres.

"Disturb" means any clearing, grading, excavating, or other similar activities. If you have any questions about this item, please call the storm water technical staff at (512)239-4671.

4. Discharge Information

4 (a). The storm water may be discharged directly to a receiving stream or through a MS4* from your site. It eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. You must provide the name of the water body that receives the discharge from the site (a local stream or lake).

4 (b). The classified segment number(s) is REQUIRED to get coverage. Go to the link to find the segment number of the classified water body where storm water will flow <http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/viewer/viewer.html> . Call Water Quality Assessments at 512/239-4671 for further assistance. Another source for segments is: http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/gi/gi-316/index.html

4 (c). If any surface water body(s) receiving discharges from the construction site are on the latest EPA-approved CWA § 303(d) list of impaired waters, provide the name(s) of the water body(s).

EPA approved CWA 303d list of impaired waters can be found at: [Texas Water Quality Inventory and 303\(d\) List - Texas Commission on Environmental Quality - www.tceq.state.tx.us](http://www.tceq.state.tx.us)

4 (d). Identify the MS4* Operator name if the storm water discharge is into an MS4.

***MS4 is an acronym for Municipal separate storm sewer system. MS4 is defined as a separate storm sewer system owned or operated by a state, city, town, county, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law such as a sewer district, flood control or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, that discharges to water in the state.**

For assistance, you may call the technical staff of the Water Quality Assessment & Standards Section at 512/239-4671.

4 (e). Edwards Aquifer Rule

See maps on the TCEQ website to determine if the site is located within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer at http://www.tceq.state.tx.us/compliance/field_ops/eapp/viewer.html.

If the discharge or potential discharge is within the Recharge Zone, Contributing Zone, or Contributing Zone within the Transition Zone of the Edwards Aquifer, a site specific authorization approved by the Executive Director under the Edwards Aquifer Protection Program (30 TAC Chapter 213) is required before construction can begin.

The general permit requires the approved Contributing Zone Plan or Water Pollution Abatement Plan to be included as a part of the Storm Water Pollution Prevention Plan. The certification must be answered "Yes" for coverage under the general permit.

E. CERTIFICATIONS

Failure to indicate "Yes" to ALL of the certification items may result in denial of coverage under the general permit.

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code §305.44

IF YOU ARE A CORPORATION:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or

similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to §305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512/239-0600.

30 Texas Administrative Code

§305.44. Signatories to Applications.

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding \$25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

**Texas Commission on Environmental Quality
General Permit Payment Submittal Form
\$325 for a paper Construction NOI Application Fee**

Use this form to submit your Application Fee only if you are mailing your payment.

- Complete items 1 through 5 below:
- Staple your check in the space provided at the bottom of this document.
- Do not mail this form with your NOI form.
- Do not mail this form to the same address as your NOI.

Mail this form and your check to:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL

Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

Fee Code: **GPA**

General Permit: TXR150000

1. Check / Money Order No:

2. Amount of Check/Money Order:

3. Date of Check or Money Order:

4. Name on Check or Money Order:

5. NOI INFORMATION

If the check is for more than one NOI, list each Project/Site (RE) Name and Physical Address exactly as provided on the NOI. **DO NOT SUBMIT A COPY OF THE NOI WITH THIS FORM AS IT COULD CAUSE DUPLICATE PERMIT ENTRIES.**

See Attached List of Sites (If more space is needed, you may attach a list.)

Project/Site (RE) Name:

Project/Site (RE) Physical Address:

Staple Check In This Space



EPA NPDES Construction Inspection Form

The following inspection is being performed in compliance with Part 3.10. of the NPDES Region 6 Storm Water Construction General Permit [68 FR 39087, July 7, 2003]. Qualified personnel (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, placement and effectiveness of structural control measures, and locations where vehicles enter or exit the site. Inspections shall be performed either once every 7 days (this option not available in New Mexico per Part 9.C.1.c.) or once every 14 days and within 24 hours of the end of a storm event of 0.5 inches or greater. Where sites have been temporarily stabilized, runoff is unlikely due to winter conditions, or during seasonal arid periods in arid areas (0-10 inches of rainfall annually) and semi-arid areas (10-20 inches annually) such inspections shall be conducted at least once every month. This form is primarily intended for use with construction projects in New Mexico. Permittees on Indian Country lands in Texas, Oklahoma, Louisiana and Arkansas and some oil and gas facilities in Texas and Oklahoma may use this form if they are eligible for this permit and EPA is their NPDES permitting authority. Other facilities need to check with their NPDES authority before using this form.

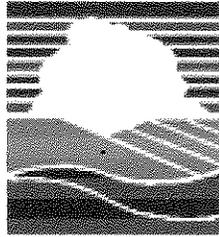
If you do not know your NPDES Permit Number, contact the NOI Processing Center at 866-352-7755. This form was prepared as an example and it is not a required form for use with the permit. Alternative forms may be used if they contain all of the required information as set forth in the permit. This form and additional information regarding the NPDES Region 6 storm water program may be found on the Internet at www.epa.gov/region6/gen/w/formsw.htm. Any person with a complaint about the operation of this facility in regards to this permit should contact EPA Region 6 at (214)665-8060.

Permit Number(s) covered by this inspection (e.g., owners, developers, general contractor, builders).	
Signature and Certification in accordance with Appendix G, Section 11 of the permit.	<small>I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (Clean Water Act, 33 U.S.C. 1251 et seq.)</small>
Date of Inspection.	
Inspector Name.	
Is there a copy of the permit language with the SWPPP?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is the inspector qualified and are the qualifications documented in the SWPPP?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is an NPDES storm water construction sign posted at the entrance for all permittees?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>You may want to use EPA Region 6 construction checklist to assure components of the SWPPP are complete. This form, the construction sign, and the checklist are available on the Region 6 NPDES Storm Water Forms and Documents web page which may be found on the internet at http://www.epa.gov/earth1r6/gen/w/formsw.htm In addition to the checklist, you should provide a narrative (see next page) on the existing Best Management Practices and Structural Controls found during each inspection. Any problems identified in an inspection should be corrected within 7 days. The inspection should cover all components of the SWPPP and all potential pollutants. While eroded soil is the primary pollutant of concern, do not forget to inspect for other pollutant sources such as fuel tanks, paints, solvents, stabilization materials, concrete hardner, batch plants, and construction debris. The inspector will need to update the SWPPP to reflect findings of the inspection. The site map should be updated after an inspection to show controls that have been added or removed, to ensure the site map is kept current in accordance with Part 3.11.A. of the permit.</p>	

Narrative Findings of the inspection:

Observations should include any findings of Best Management Practices or controls that are not in accordance with the SWPPP. If a control is not in place or failed, observe the reason why. A control removed temporarily for work is not necessarily a violation if properly recorded in the SWPPP. If it has been removed, record why it was removed and, if applicable, when it will be reinstalled. If the control has failed, observe the conditions so a conclusion may be made as to whether the control failed for improper maintenance or improper design. The qualified inspector will know when a failed control is inadequate and should be replaced by an improved control mechanism. Qualified inspectors are to have authority to make changes to the SWPPP to assure compliance. Controls that have not been installed should be given a reason why they are not installed and/or a scheduled date for installation if they are designed for a later phase of construction. After the inspection, the SWPPP and its site map should be updated to reflect current conditions of controls and Best Management Practices at the time of the inspection. This includes removing uninstalled controls from the site map or otherwise denoting on the site map if they are no longer installed if the controls have been removed because they are no longer necessary (e.g., stabilization has been achieved in that area).

Part 3.10.G. of the permit: For each inspection required above, you must complete an inspection report. At a minimum, the inspection report must include: 1. The inspection date; 2. Names, titles, and qualifications of personnel making the inspection; 3. Weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred; 4. Weather information and a description of any discharges occurring at the time of the inspection; 5. Location(s) of discharges of sediment or other pollutants from the site; 6. Location(s) of BMPs that need to be maintained; 7. Location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location; 8. Location(s) where additional BMPs are needed that did not exist at the time of inspection; and 9. Corrective action required including any changes to the SWPPP necessary and implementation dates.



SMALL CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Storm Water Program
TPDES GENERAL PERMIT TXR150000

The following information is posted in compliance with **Part II.E.2.** of the TCEQ General Permit Number TXR150000 for discharges of storm water runoff from small construction sites. Additional information regarding the TCEQ storm water permit program may be found on the internet at:

http://www.tceq.state.tx.us/nav/permits/wq_construction.html

Operator Name:	
Contact Name and Phone Number:	
Project Description: <i>Physical address or description of the site's location, estimated start date and projected end date, or date that disturbed soils will be stabilized</i>	
Location of Storm Water Pollution Prevention Plan:	

For Small Construction Activities Authorized Under Part II.E.2. (Obtaining Authorization to Discharge) the following certification must be completed:

I _____ (Typed or Printed Name Person Completing This Certification) certify under penalty of law that I have read and understand the eligibility requirements for claiming an authorization under Part II.E.2. of TPDES General Permit TXR150000 and agree to comply with the terms of this permit. A storm water pollution prevention plan has been developed and will be implemented prior to construction, according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4. I am aware there are significant penalties for providing false information or for conducting unauthorized discharges, including the possibility of fine and imprisonment for knowing violations.

Signature and Title _____ Date _____

Date Notice Removed
MS4 operator notified per Part II.F.3.

**Notice of Termination (NOT) for Authorizations under
TPDES General Permit TXR150000
General Information and Instructions**

GENERAL INFORMATION

Where to Send the Notice of Intent (NOI):

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
P.O. Box 13087
Austin, TX 78711-3087

BY OVERNIGHT/EXPRESS MAIL

Texas Commission on Environmental Quality
Storm Water Processing Center (MC228)
12100 Park 35 Circle
Austin, TX 78753

TCEQ Contact list:

Application Processing Questions relating to the status and form requirements:	512/239-4671
Technical Questions relating to the general permit:	512/239-4671
Environmental Law Division:	512/239-0600
Records Management for obtaining copies of forms submitted to TCEQ:	512/239-0900
Information Services for obtaining reports from program data bases (as available):	512/239-DATA (3282)
Financial Administration's Cashier's office:	512/239-0357 or 512/239-0187

Notice of Termination Process:

A Notice of Termination is **effective on the date postmarked for delivery to TCEQ**.
When your NOT is received by the program, the form will be processed as follows:

1. **Administrative Review:** The form will be reviewed to confirm the following:

- the permit number is provided
- the permit is active and has been approved
- the entity terminating the permit is the current permittee
- the site information matches the original permit record
- the form has the required original signature with title and date

2. **Notice of Deficiency:** If an item is incomplete or not verifiable as indicated above, a phone call will be made to the applicant to clear the deficiency.
A letter will not be sent to the permittee if unable to process the form.

3. **Confirmation of Termination:** A Notice of Termination Confirmation letter will be mailed to the operator.

General Permit (Your Permit)

Coverage under the general permit begins **48 hours after a completed NOI is postmarked for delivery to the TCEQ**. You should have a copy of your general permit when submitting your application. You may view and print your permit for which you are seeking coverage, on the TCEQ web site www.tceq.state.tx.us

General Permit Forms

The Notice of Intent (NOI), Notice of Termination (NOT), and Notice of Change (NOC) with instructions are available in Adobe Acrobat PDF format on the TCEQ web site www.tceq.state.tx.us.

Change in Operator

An authorization under the general permit is not transferable. If the operator or owner of the regulated entity changes, the present permittee must submit a Notice of Termination and the new operator must submit a Notice of Intent. The NOT and NOI must be submitted not later than 10 days prior to the change in Operator status.

TCEQ Central Registry Core Data Form

The Core Data Form has been incorporated into this form. **Do not send a core data form to TCEQ.**

After final acknowledgment of coverage under the general permit, the program will assign a Customer Number (CN) and Regulated Entity Number (RN). For Construction Permits, a new RN will be assigned for each Notice of Intent filed with TCEQ, since construction project sites can overlap with other Customers. The RN assigned to your construction project will not be assigned to any other TCEQ authorization.

You can find the information on the Central Registry web site at www4.tceq.state.tx.us/crpub. You can search by the Regulated Entity (RN), Customer Number (CN) or Name (Permittee), or by your permit number under the search field labeled "Additional ID". Capitalize all letters in the permit number.

The Customer (Permittee) is responsible for providing consistent information to the TCEQ, and for updating all CN and RN data for all authorizations as changes occur. For General Permits, a Notice of Change form must be submitted to the program area.

Annual Water Quality Fee: This fee is assessed to operators with an active authorization under the general permit on September 1 of each year. The operator will receive an invoice for payment of the annual fee in November of each year. The payment will be due 30 days from the invoice date. A 5% penalty will be assessed if the payment is received by TCEQ after the due date. Annual fee assessments cannot be waived as long as the authorization under the general permit is active on September 1.

It's important for the operator to submit a **Notice of Termination (NOT)** when coverage under the general permit is no longer required. A NOT is effective on the postmarked date of mailing the form to TCEQ. It is recommended that the NOT be mailed using a method that documents the date mailed and received by TCEQ.

• **Mailed Payments:**

You must return your payment with the billing coupon provided with the billing statement.

• **ePAY Electronic Payment:**

Go to www.tceq.state.tx.us/epay

You must enter your account number provided at the top portion of your billing statement. Payment methods include Mastercard, Visa, and electronic check payment (ACH). A transaction over \$500 can only be made by ACH.

INSTRUCTIONS FOR FILLING OUT THE NOT FORM

A. OPERATOR (current permittee.)

1. TCEQ Issued Customer Number (CN)

2. Legal Name of Operator

The operator must be the same entity as previously submitted on the original Notice of Intent for the permit number provided.

3. Operator Mailing Address

Provide a complete mailing address for receiving mail from the TCEQ. Update the address if different than previously submitted in the Notice of Intent or Notice of Change.

4. Phone Number, Fax Number, and E-mail Address

Provide updated contact information.

B. REGULATED ENTITY (RE) INFORMATION ON PROJECT OR SITE

1. Regulated Entity Reference Number (RN)

2. Site/Project Name/Regulated Entity

Provide the name of the site as previously submitted in the Notice of Intent for the permit number provided.

3. Site/Project (RE) Physical Address

Provide the physical address or location access description as previously submitted for the permit number provided.

C. REASON FOR TERMINATION

Indicate the reason for terminating the permit by checking one of the options. If the reason is not listed then provide an attachment that explains the reason for termination.

Please read your general permit carefully to determine when to terminate your permit. Permits will not be reactivated after submitting a termination form. The termination is effective on the date postmarked for delivery to TCEQ.

D. CERTIFICATIONS

The certification must bear an original signature of a person meeting the signatory requirements specified under 30 Texas Administrative Code (TAC) §305.44.

IF YOU ARE A CORPORATION:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(1) (see below). According to this code provision, any corporate representative may sign an NOI or similar form so long as the authority to sign such a document has been delegated to that person in accordance with corporate procedures. By signing the NOI or similar form, you are certifying that such authority has been delegated to you. The TCEQ may request documentation evidencing such authority.

IF YOU ARE A MUNICIPALITY OR OTHER GOVERNMENT ENTITY:

The regulation that controls who may sign an NOI or similar form is 30 Texas Administrative Code §305.44(a)(3) (see below). According to this code provision, only a ranking elected official or principal executive officer may sign an NOI or similar form. Persons such as the City Mayor or County Commissioner will be considered ranking elected officials. In order to identify the principal executive officer of your government entity, it may be beneficial to consult your city charter, county or city ordinances, or the Texas statute(s) under which your government entity was formed. An NOI or similar document that is signed by a government official who is not a ranking elected official or principal executive officer does not conform to

§305.44(a)(3). The signatory requirement may not be delegated to a government representative other than those identified in the regulation. By signing the NOI or similar form, you are certifying that you are either a ranking elected official or principal executive officer as required by the administrative code. Documentation demonstrating your position as a ranking elected official or principal executive officer may be requested by the TCEQ.

If you have any questions or need additional information concerning the signatory requirements discussed above, please contact the Texas Commission on Environmental Quality's Environmental Law Division at 512/239-0600.

30 Texas Administrative Code

§305.44. Signatories to Applications.

(a) All applications shall be signed as follows.

(1) For a corporation, the application shall be signed by a responsible corporate officer. For purposes of this paragraph, a responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding \$25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit or post-closure order applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

(2) For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this paragraph, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., regional administrator of the EPA).

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 1077-032 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- B. ASTM D 3666-04 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
- C. ASTM D 3740-042 - 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 329-03 - Specification for Minimum Requirements for Agencies Engaged 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 City will select, employ, and pay for services of an independent testing laboratory to perform inspection and testing identified in Part 3, Execution, of individual Specification sections.
- B. The Contractor shall employ and pay for services of an independent testing laboratory or laboratories to perform inspection and testing identified in Part 2, Products, of individual Specification sections.
- C. Employment of a testing laboratory by the Engineer shall not relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- D. The Contractor will have the minimum 2-hour charge for testing laboratory time deducted from the estimate for payment if operations requiring testing or inspection are canceled without prior notification.
- E. The Contractor will have the cost of retesting deducted from the estimate for payment whenever failed work must be removed and replaced and retested.

1.04 QUALIFICATION OF LABORATORY

- A. Meet laboratory requirements of ASTM E 329-03 and applicable requirements of ASTM C 1077-032, ASTM D 3666-04, and ASTM D 3740-042.
- B. Meet the ISO/TEC Guide 25 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Specification sections.
- C. Where a laboratory subcontracts any part of the testing services, such work shall be placed with a laboratory complying with the requirements of this Section.

1.05 LABORATORY REPORTS

- A. The testing laboratory shall provide and distribute copies of laboratory reports to the distribution list provided by the Engineer at the pre-construction conference.
- B. One copy of each laboratory report distributed or faxed to the Contractor shall be kept at the site field office for the duration of the project.
- C. Before close of business on the working day following test completion and review, reports which indicate failing test results shall be transmitted immediately via fax from the testing laboratory to the material supplier, Contractor, and Engineer.

1.06 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of the Contractor.
- 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 the Engineer and for testing laboratory personnel.
- B. Provide to the testing laboratory a copy of the construction schedule and a copy of each update to the construction schedule.
- C. Notify the Engineer and the testing laboratory during normal working hours of the day previous to the expected time for operations requiring inspection and testing services. If the Contractor fails to make timely prior notification, then the Contractor shall not proceed with the operations requiring inspection and testing services.

- D. Notify the Architect/Engineer 24 hours in advance if the Specification requires the presence of the Architect/Engineer for sampling or testing.
- E. Request and monitor testing as required to provide timely results and to avoid delay to the Work. Provide samples to the laboratory in sufficient time to allow the required test to be performed in accordance with specified test methods before the intended use of the material.
- 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 the site or at source of products to be tested; and to facilitate tests and inspections including storage and curing of test samples.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 CONDUCTING TESTING

- A. Laboratory sampling and testing specified in individual Specification sections shall conform to the latest issues of ASTM standards, or other recognized test standards as approved by the OWNER.
- B. The 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 the testing laboratories employed by the Contractor.

END OF SECTION

Section 01555

TRAFFIC CONTROL AND REGULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for signs, signals, control devices, flares, lights and traffic signals, as well as parking control.
- B. Requirement for and qualifications of flagmen.

1.02 SUBMITTALS

- A. The Contractor shall provide such information and records regarding the use of qualified flagmen to verify that the Contractor's use of "peace officers" as flagmen is in compliance with the Contract Documents and Texas law, including but not limited to, Article 4413 (29bb), commonly referred to as the Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.
- B. The Contractor shall provide such information and records regarding the use of qualified flagmen to verify that the Contractor's use of "certified flagmen" as flagmen is in compliance with the Contract Documents and applicable City ordinance.

1.03 UNIT PRICES

- A. No separate payment will be made for Traffic Control and Regulation or Flagmen under this Section. Include payment in unit price for related sections.

1.04 FLAGMEN

- A. Use flagmen, qualified as described under paragraph 1.04.B, Uniformed Peace Officers, or paragraph 1.04.C, Certified Flagmen, to control, regulate, and direct the even flow or movement of vehicular or pedestrian traffic when construction operations encroach on public traffic lanes.
- B. Uniformed Peace Officer: A person who has full-time employment as a peace officer and who receives compensation as a flagman for private employment as an individual employee or independent contractor. Private employment may be either an employee-employer relationship or on an individual basis. A flagman may not be in the employ of another peace officer and may not be a reserve peace officer.

1. A peace officer is defined as:
 - a. Sheriffs and their deputies;
 - b. Constables and deputy constables;
 - c. Marshals or police officers of an incorporated city, town, or village; or
 - d. As otherwise provided by Article 2.12, Code of Criminal Procedure, as amended.

 2. A person who has full-time employment as a peace officer is one who is actively employed in a full-time capacity as a peace officer working, on average, a minimum of 32 paid hours per week, being paid at a rate of pay not less than the prevailing minimum hourly wage rate as set by the federal Wage and Hour Act and entitled to the full benefits of participation in any retirement plan, vacation, holidays, and insurance benefits. A reserve peace officer does not qualify, under this definition, as a peace officer.
- C. Certified Flagman: A person who receives compensation as a flagman and who meets the following qualifications and requirements:
1. Formally trained and certified in traffic control procedures through the City's Department of Public Works & Engineering's E. B. Cape Center.
 2. Required to wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices.
 3. English speaking, with Spanish as an advantageous, but not required, primary or secondary language.
 4. Required to carry proof of training / certification, such as photographic identification card issued by the training institute, to allow the Engineer to easily determine that necessary full-time traffic control is actually provided, when and where evaluation work encroaches upon traffic lanes.

PART 2 PRODUCTS

2.01 SIGNS, SIGNALS, AND DEVICES

- A. Comply with Texas State Manual on Uniform Traffic Control Devices.
- B. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.

PART 3 EXECUTION

3.01 PUBLIC ROADS

- A. Abide by laws and regulations of governing authorities when using public roads. If the Contractor's work requires that public roads be temporarily impeded or closed, approvals shall be obtained from governing authorities and permits paid for before starting any work. Coordinate activities with the Engineer.
- B. Contractor shall maintain at all times a 10-foot-wide all-weather lane adjacent to work areas which shall be kept free of evaluation equipment and debris and shall be for the use of emergency vehicles, or as otherwise provided in the traffic control plan.
- C. Contractor shall not obstruct the normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by the Engineer.
- D. Contractor shall maintain local driveway access to residential and commercial properties adjacent to work areas at all times.
- E. Cleanliness of Surrounding Streets - Keep streets used for entering or leaving the job area free of excavated material, debris, and any foreign material resulting from construction operations.

3.02 PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and City's operations.
- B. Monitor parking of personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.03 FLARES AND LIGHTS

- A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.04 TRAFFIC SIGNS AND SIGNALS

- A. Install traffic control devices at approaches to the site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct traffic around the evaluation survey work area.
- B. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.

- C. Relocate traffic signs and signals as Work progresses to maintain effective traffic control.

3.05 REMOVAL

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused during evaluation.

END OF SECTION

Section 01570

STORM WATER POLLUTION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Implementation of Storm Water Pollution Prevention Plans (SW3P) described in Section 01410— TPDES Requirement
- B. Installation and maintenance of storm-water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.
- C. Filter Fabric Fences:
 - 1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
 - 2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized low areas.
- D. Straw Bale Fence: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope.

1.02 MEASUREMENT AND PAYMENT

- A. UNIT PRICES
 - 1. Payment for filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
 - 2. Payment for reinforced filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
 - 3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.
 - 4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.
 - 5. Payment for storm-water-pollution-prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping includes diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.

6. Payment for straw bale barrier, if included in Document 00410 - Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm-water-pollution-prevention structures.
 7. Payment for brush berm, if included in Document 00410 - Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm- water-pollution-prevention structures.
 8. Payment for sandbag barrier, if included in Document 00410 - Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm-water-pollution- prevention structures.
 9. Payment for sediment basin with pipe outlet or stone outlet, if included in Document 00410 - Bid Form, is on a square yard basis, if not include in cost of storm-water-pollution-prevention structures.
 10. Payment for inlet protection barriers, if included in Document 00410 - Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm-water-pollution- prevention structures.
 11. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCE STANDARDS

A. ASTM

1. A 36 - Standard Specification for Carbon Structural Steel.
2. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (60C) kN-m/m³)).
3. D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.04 SYSTEM DESCRIPTIONS

A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.

B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.

C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.

D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.

E. Sediment traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

1.05 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit manufacturers' literature for product specifications and installation instructions.

C. Submit manufacturer's catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.

D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.

E. Submit shop drawings for Drop Inlet Baskets.

PART 2 PRODUCTS

2.01 CONCRETE

A. Concrete: Class B in accordance with Section 03315 — Concrete for Utility Construction or as shown on the Drawings.

2.02 AGREGATE MATERIALS

- A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.
- B. Provide gravel lining in accordance with Section 2320 — Utility Backfill Materials or as shown on the drawings.
- C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
- D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.03 PIPE

- A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Section 02505- High Density Polyethylene (HDPE) Solid and Profile Wall Pipe and Section 02506 Polyvinyl Chloride Pipe or as shown on the Drawings.
- B. Inlet Pipes: Galvanized steel pipe in accordance with Section 02642 Corrugated Metal Pipe or as shown on the Drawings.
- C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.04 GEOTEXTILE FILTER FABRIC

- A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
- B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.
- C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees
- D. Mirafi, Inc., Synthetic Industries, or equivalent

2.05 FENCING

- A. Wire Fencing: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.
- B. Fence Stakes: Nominal 2 by 2 inch moisture-resistant treated wood or steel posts (mm. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety

caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

2.06 SANDBAGS

- A. Provide woven material made of polypropylene, polyethylene, or polyamide material.
 - 1. Minimum unit weight of four ounces per square yard.
 - 2. Minimum grab strength of 100 psi in any principal direction (ASTM D4632)
 - 3. Mullen burst strength exceeding 300 psi (ASTM D3786).
 - 4. Ultraviolet stability exceeding 70 percent.
 - 5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: 50 to 125 pounds.

2.07 DROP INLET BASKET

- A. Provide steel frame members in accordance with ASTM A36.
- B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.08 STRAW BALE

- A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

PART 3 EXECUTION

3.01 PREPARATION, INSTALLATION AND MAINTAINANCE

- A. Provide erosion and sediment control structures at locations shown on the Drawings.
- B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.

- C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manger to remove and discard existing system.
- D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Section 01576 - Waste Material Disposal.
- E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Section 01576 - Waste Material Disposal.
- F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Section 02315 Roadway Excavation or Section 2317 Excavation and Backfill for Utilities.
- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.
- H. Protect existing trees and plants in accordance with Section 1562 — Tree and Plant Protection.

3.02 SEDIMENT TRAPS

- A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
- B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.
- C. Use fill material for embankment in accordance with Section 02320 — Utility Backfill Materials.
- D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.
- E. Stone outlet sediment traps:
 - 1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.
 - 2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be a minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.

- F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.
- G. Remove sediment deposits when design basin volume is reduced by one-third or sediment level is one foot below principal spillway crest, whichever is less.

3.03 FILTER FABRIC FENCE CONSTRUCTION METHODS

A. Fence Type 1:

1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory preassembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.
3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.
4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
5. Backfill and compact trench.

B. Fence Type 2:

1. Layout fence same as for Type 1.
2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.
3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
4. Install trench same as for Type 1.
5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
7. Backfill and compact trench.

- C. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.
- D. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.
- E. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
- F. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.
- G. **Triangular Filter Fabric Fence Construction Methods**
 - 1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
 - 2. Secure triangular fabric filter fence in place using one of the following methods:
 - a. Toe-in skirt 6 inches with mechanically compacted material;
 - b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock;
 - or
 - c. Trench-in entire structure 4 inches.
 - 3. Anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
 - 4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.
- H. **Reinforced Filter Fabric Barrier Construction Methods**
 - 1. Attach woven wire fence to fence stakes.
 - 2. Securely fasten filter fabric material to wire fence with tie wires.
 - 3. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.

4. Remove sediment deposits when silt reaches depth one-third height of barrier or 6 inches, whichever is less.

3.04 DIKE AND SWALE

- A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.
- B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.
- C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.
- D. Clear in accordance with Section 2233 — Clearing and Grubbing Compact embankments in accordance with Section 2315 — Roadway Excavation.
- E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.05 DOWN SPOUT EXTENDER

- A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Section 2317 - Bedding and Backfill for Utilities.

3.06 PIPE SLOPE DRAIN

- A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.
- B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.
- C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.
- D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.

- E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.07 PAVED FLUME

- A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
- B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
- C. Construct permanent paved flumes in accordance with Drawings.
- D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.08 LEVEL SPREADER

- A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.
- B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.09 INLET PROTECTION BARRIER

- A. Place sandbags and filter fabric fences at locations shown on the SW3P.

3.10 DROP INLET BASKET CONSTRUCTION METHODS

- A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SW3P.
- B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.
- C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.
- D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.11 STRAW BALE FENCE CONSTRUCTION METHODS

- A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
- B. Embed bale in soil a minimum of 4 inches.

- C. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.
- D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
- E. Replace with new straw bale fence every two months or as required by Project Manager.

3.12 BRUSH BERM CONSTRUCTION METHODS

- A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
- B. Use woody brush and branches having diameter less than 2-inches with 6- inches overlap. Avoid incorporation of annual weeds and soil into brush berm.
- C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.
- D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Section 01575- Stabilized Construction Exit.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not waterhose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water

conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.

- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.16 VEHICLE EQUIPMENT WASHING AREAS

- A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Section 01575- Stabilized Construction Exit. Install gravel or rock base beneath wash areas.
- B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into watercourses or storm water conveyance systems.
- C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

- A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.
- E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.
- F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold area of bare soil exposed at one time to a minimum.
 - 2. Provide temporary controls such as berms, dikes, and drains.

- G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.
- H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
- I. Dispose of sediments offsite, not in or adjacent to streams or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.
- J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8- inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.
- K. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.
- L. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

- A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Project Manager.
- B. Dispose of sediments and waste products following Section 01576- Waste Material Disposal.

END OF SECTION

Section 01575

STABILIZED CONSTRUCTION EXIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.02 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.
- B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.03 UNIT PRICES

- A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.
- B. When indicated in the Unit Price Schedule, include stabilized exits under payment for Street Cleaning as Required by NPDES, including stabilized construction roads, parking areas, exits, and truck washing areas will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, embankment and excavation, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, redressing of aggregates and stones, cleaning of streets, and removal of erosion and sediment control systems at the end of construction.

1.04 REFERENCES

- A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

PART 2 PRODUCTS

2.01 GEOTEXTILE FABRIC

- A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632), and the equivalent opening size between 50 and 140.

- C. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0°F to 120°F.
- D. Representative Manufacturers: Mirafi, Inc., or equal.

2.02 COARSE AGGREGATES

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

<u>Sieve Size</u> <u>(Square Mesh)</u>	<u>Percent Retained</u> <u>(By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

- A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.
- B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the City Engineer to allow soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the City Engineer to remove and discard the existing system.
- D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the City. Remove stabilized construction roads and exits promptly when directed by the City Engineer. Discard removed materials off site.

- E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.
- F. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.
- G. Conduct all construction operation under this Contract in conformance with the erosion control practices described in the Specification 01410 – TPDES Requirements.

3.02 CONSTRUCTION METHODS

- A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.
- B. Provide stabilized construction exits, and truck washing areas when approved by City Engineer, of the sizes and locations where shown on Drawings or as specified in this Section.
- C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas which drain into a drainage system protected by erosion and sediment control measures.
- D. Details for stabilized construction exit are shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.
- E. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.
- F. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

- G. The length of the stabilized area shall be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than the full width of all points of ingress or egress.
- H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.
- I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by City Engineer.
- J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the City Engineer. These methods include the following:
 - 1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in an application thickness of at least 8 inches.
 - 2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.
 - 3. Steel Mats - Perforated mats placed across perpendicular support members.

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. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances.
- B. 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.

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 Development Permit has been obtained. Excess material placed in a "100-year Flood Hazard Area" within the City, without a "Development Permit", shall be removed by Contractor at no additional cost to the City.
- 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 02260

TRENCH SAFETY SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Trench Safety System for the construction of trench excavations.
- B. Trench Safety System for structural excavations that fall under provisions of State and Federal trench safety laws.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Measurement for Trench Safety Systems used on trench excavations is on a linear foot basis measured along the centerline of the trench, including manholes and other line structures.
 - 2. No payment will be made for Trench Safety Systems for structural excavations under this section. Include payment for Trench Safety System in applicable structure installation sections.
 - 3. Refer to Section 01270 - Measurement and payment for unit price procedures.
- 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. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- B. The Trench Safety System requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.
- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittal Procedures.

- B. Submit a safety program specifically for the construction of trench excavation. Design the Trench Safety Program to be in accordance with OSHA 29 CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.
- D. Review of the safety program by the City Engineer will only be in regard to compliance with this specification and will not constitute approval by the City Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

1.05 REGULATORY REQUIREMENTS

- A. Install and maintain Trench Safety Systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. A reproduction of the OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209 is available upon request to Contractors bidding on City projects. The City assumes no responsibility for the accuracy of the reproduction. The Contractor is responsible for obtaining a copy of this section of the Federal Register.
- C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., § 756.021 (Vernon 1991).

1.06 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the City, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the City in case the City is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and maintain Trench Safety Systems in accordance with provisions of OSHA 29 CFR.
- B. Install specially designed Trench Safety Systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the Contractor's trench safety program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation

3.02 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the Trench Safety Systems to ensure that the installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken by Contractor to safeguard personnel entering the trench.
- C. Maintain a permanent record of daily inspections.

3.03 FIELD QUALITY CONTROL

- A. Contractor shall verify specific applicability of the selected or specially designed Trench Safety Systems to each field condition encountered on the project.

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 unit price or lump sum for construction of structures.
2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- 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 geotechnical report.

- 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 City 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 if required in Section 01010 - Summary of Work.
- E. Submit backfill material sources and product quality information in accordance with requirements of specifications.

- F. Submit project record documents under provisions of specifications. 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 City in as specified in this Section.
- B. Contractor shall perform embedment and backfill material source qualification testing in accordance with requirements of specifications.

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 specifications. 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 City.

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 City Engineer.
- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify City 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 City 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 City Engineer.
- J. After completion of the structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by City 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 City 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 City 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 City 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 City 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 City Engineer.
- C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by the City 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 City Engineer, at no additional cost to the City.
- 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 unit price for installed underground piping, sewer, conduit, or duct work.
- 2. No separate or additional payment will be made for surface water control, ground water control, or for excavation drainage. Include in the unit price for the installed piping, sewer, conduit, or duct work.
- 3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- 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 specifications.
- 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 specifications.

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 EXECUTION

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.

<u>Nominal Pipe Size, Inches</u>	<u>Minimum Trench Width, Inches</u>
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. 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 02319

BORROW

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Soil materials for embankment.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. Payment for borrow is on a cubic yard basis calculated by theoretical quantities using the average end area method based on the Drawings.
2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- 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 REFERENCES

- A. ASTM D 2216 - Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
- B. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit location and description of proposed borrow area for approval.
- C. Submit material samples for testing.

PART 2 PRODUCTS

2.01 SOIL MATERIAL

- A. Borrow material used for embankment shall be graded free of lumps greater than 6 inches, rocks larger than 3 inches, organic material, chemical waste or other contamination, and debris. Take borrow material from sources approved by City Engineer.

- B. Material shall have a plasticity index not less than 12, nor more than 20 when tested in accordance with ASTM D 4318. Maximum liquid limit shall be 45, unless approved by City Engineer. Do not use a blend of cohesive and granular soils to achieve the required plasticity index.

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify City Engineer and testing laboratory 5 days in advance of opening borrow source to permit obtaining samples for qualification testing. If the material does not meet specification requirements, locate another source of borrow.
- B. Clear approved source area of trees, stumps, brush, roots, vegetation, organic matter, and other unacceptable material before excavation.

3.02 TESTS

- A. Tests and analysis of soil materials will be performed in accordance with ASTM D 4318 and ASTM D 2216 under provisions of Section 01454 - Testing Laboratory Services.

3.03 EXCAVATION

- A. Provide adequate drainage of surface water so that surface water run off does not enter borrow pit excavation.

3.04 HAULING

- A. Use covered trucks. Conform to requirements of Section 01555 - Traffic Control and Regulation.

3.05 EMBANKMENT

- A. Conform to requirements of Section 02330 - Embankment.

END OF SECTION

Section 02321

CEMENT STABILIZED SAND

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cement stabilized sand material.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. No payment will be made for cement stabilized sand under this Section. Include payment for cement stabilized sand in unit price for applicable utility or structure installation section.
 2. If use of cement stabilized sand is allowed based on the City Engineer's direction, the extra unit price item will be paid on a per ton basis. A conversion between volume calculated based on theoretical limits and total weight will be made based on a ratio of 1.64 tons per cubic yard.
 3. Refer to Paragraph 3.03 B for material acceptance criteria for partial payments.
 4. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- D. ASTM C 123 - Standard Test Method for Lightweight Pieces in Aggregate.
- E. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- F. ASTM C 150 - Specification for Portland Cement.

- G. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
- H. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- J. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- K. ASTM D 3665 - Practice for Random Sampling of Construction Materials.
- L. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with the requirements of Paragraph 2.03, Material Qualifications.

1.05 DESIGN REQUIREMENTS

- A. Sand-cement mixture shall produce a minimum unconfined compressive strength of 100 pounds per square inch in 48 hours.
 - 1. Design will be based on strength specimens molded in accordance with ASTM D 558 at a moisture content within 3 percent of optimum and within 4 hours of batching.
 - 2. Determine minimum cement content from production data and statistical history. Mix shall contain not less than 1.1 sacks of cement per ton of dry sand.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C 150.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, and the following requirements:
 - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by the United Soil Classification System of ASTM D 2487.

2. Deleterious materials:
 - a. Clay lumps, ASTM C 142; less than 0.5 percent.
 - b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - c. Organic impurities, ASTM C 40, color no darker than the standard color.
3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.

- C. Water: Potable water, free of oils, acids, alkalies, organic matter, or other deleterious substances, meeting requirements of ASTM C 94.

2.02 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in a pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Material not placed and compacted within 4 hours after mixing shall be rejected.

2.03 MATERIAL QUALIFICATION

- A. Determine the target cement content of the material as follows:
 1. Obtain samples of sand-cement mixtures at the production facility representing a range of cement content consisting of at least three points.
 2. Complete the molding of samples within 4 hours after the addition of water.
 3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
 4. Perform cement content tests on each sample.
 5. Perform moisture content tests on each sample.
 6. Plot average 48-hour strength vs. cement content
 7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
- B. Test the raw sand for the following properties at the point of entry into the pug-mill:
 1. Gradation.
 2. Plasticity index.
 3. Organic impurities.

4. Clay lumps and friable particles.
 5. Lightweight pieces.
 6. Moisture content.
 7. Classification.
- C. Present the data obtained in a format similar to that provided in the sample data form attached to this Section.
- D. The target content may be adjusted if statistical history so indicates. For determination of minimum product performance use the formula:

$$f_c = 1/2 \text{ standard deviation}$$

PART 3 EXECUTION

3.01 PLACING

- A. Place sand-cement mixture in a maximum 12-inch-thick loose lift and compact to 95 percent of ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. The target moisture content during compaction is 3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at the plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

3.02 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.
- B. Samples of delivered product will be taken in the field at point of delivery for testing in accordance with ASTM D 3665.
- C. Four specimens shall be prepared and molded (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting the moisture content. Samples will be molded at approximately the same time the material is being used, but no later than 4 hours after water is added to mix.
- D. After molding, specimens will be removed from the molds and sealed in a plastic bag or similar material to minimize moisture loss. Specimens will be cured at a room temperature between 60 and 80 degrees F until ready for testing.

- E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.
- F. A strength test will be the average of the strengths of two specimens molded from the same sample of material and tested at the same age. The average daily strength will be the average of the strengths of all specimens molded during one day's production and tested at the same age.
- G. Precision and Bias: Test results shall meet the recommended guideline for precision in ASTM D 1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, the following information:
 - 1. Supplier and plant number
 - 2. Time material was batched
 - 3. Time material was sampled
 - 4. Test age (exact hours)
 - 5. Average 48-hour strength
 - 6. Average 7-day strength
 - 7. Specification section number
 - 8. Compliance / non-compliance
 - 9. Mixture identification
 - 10. Truck and ticket numbers
 - 11. The time of molding
 - 12. Moisture content at time of molding
 - 13. Required strength
 - 14. Test method designations
 - 15. Compressive strength data as required by ASTM D 1633

3.03 ACCEPTANCE

- A. The strength level of the material will be considered satisfactory if:
 - 1. The average 48-hour strength is greater than 100 psi with no individual strength test below 60 psi, or
 - 2. All 7-day individual strength tests exceed 100 psi.
- B. The material will be considered acceptable for partial payment if any 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 60 psi.
- C. The material will be considered unacceptable and subject to removal and replacement at the Contractor's expense if any individual strength test has a 7-day strength less than 60 psi.
- D. If the moving average of any three daily 48-hour averages falls below 100 psi, the supplier shall discontinue shipment to the project until that plant is capable of

producing a material which exceeds 100 psi at 48 hours. A total of five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

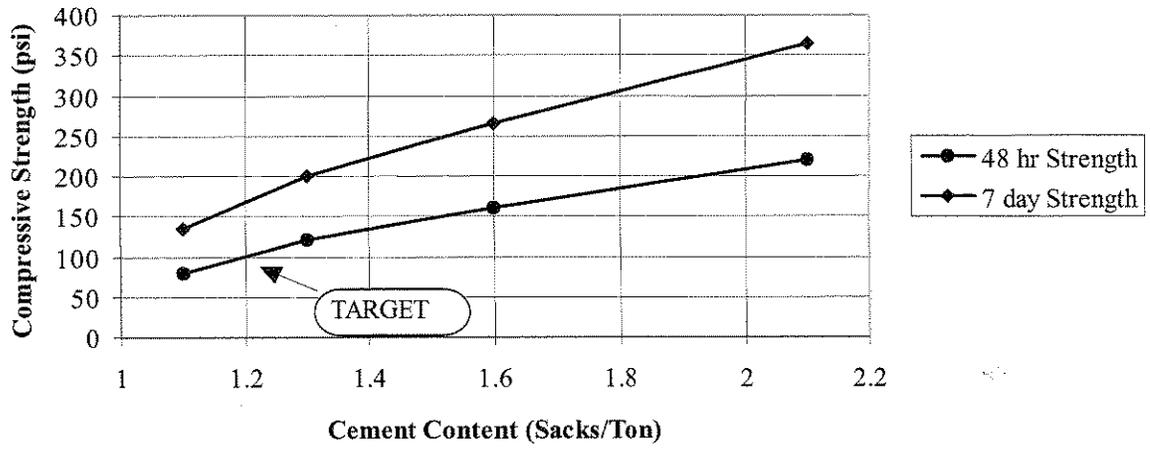
- E. The City Engineer shall maintain a data base of strength tests performed on 100 psi cement stabilized sand material for City projects. The statistical history shall be used for approval of material on future City projects.
- F. The testing laboratory shall notify the Contractor, City Engineer, and material supplier by facsimile of all tests indicating results falling below specified strength requirements.

END OF SECTION

Supplier: City Stabilized Sand	Plant No: 1 - Main Street	Date of Tests: January 1, 1997
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Item	Raw Sand	1.1 Sack	100 psi	1.5 Sack	2.0 Sack
Moisture Content	10.9	15.7	14.0	13.8	13.7
Cement Feed Dial Setting	--	2.25	2.5	2.75	3.75
Silo Pressure (psi)	--	4	4	4	4
Batch Time	10:00	10:10	10:15	10:20	10:25
Sample Time	--	10:10	10:15	10:20	10:25
Molding Time	--	12:30	12:45	1:00	1:15
Cement Content (sacks/ton)	--	1.1	1.3	1.6	2.1
Compressive Strength at 48 hrs. (avg of 2)	--	80	120	160	220
Compressive Strength at 7 days(avg of 2)	--	135	200	265	365
Sieve size	Percent Passing		COT Spec. Section 02320		
3/8 Inch	100		--		
No. 16	100		--		
No. 40	100		--		
No. 50	99		--		
No. 100	41		--		
No. 200	11		0 to 15		
Raw Sand Tests	Result		City of Tomball		
Plasticity Index	Non-Plastic		4 Maximum		
Organic Impurities	Passing		No Darker Than		
Clay Lumps & Friable Parts (%)	0.0		0.5 % Maximum		
Lightweight Pieces (%)	0.0		5.0 % Maximum		
Classification	SP-SM		SW, SP, SW-SM, SP-SM, SM		

Compressive Strength vs Cement Content



Section 02330

EMBANKMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Construction of embankments with excess excavated material and borrow.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. No separate payment will be made for embankment under this section. Include payment in unit price for excavation or borrow.
2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- 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 REFERENCES

- A. ASTM D 698 - Test Methods for Moisture-Density Relationships of Soils and Soil-Aggregate Mixtures Using 5.5 (2.49 kg) Pound Rammer, 12-inches (304.88 mm) Drop.
- B. ASTM D 1556 - Density of Soil in Place by the Sand-Cone Method.
- C. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D 3017 - Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

PART 2 PRODUCTS

2.01 MATERIALS

- A. Refer to Section 02315 - Roadway Excavation for acceptable excess materials from roadway excavation.
- B. Refer to Section 02317 - Excavation and Backfill For Utilities for acceptable excess materials from utility excavation and trenching.

- C. Refer to Section 02319 - Borrow for acceptable borrow materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify borrow and excess excavated materials to be reused are approved.
- B. Verify removals and clearing and grubbing operations have been completed.

3.02 PREPARATION

- A. Fill test pits, or stump holes and other surface irregularities such as small swales. Backfill and compact in designated lift depths to requirements for embankment compaction.
- B. Record location and plug and fill inactive water and oil wells. Conform to Texas State Health Department, Texas Commission on Environmental Quality, and Texas Railroad Commission requirements. Notify City Engineer prior to plugging wells.
- C. Excavate and dispose of unsuitable soil and other unsuitable materials which will not consolidate. Backfill and compact to requirements for embankment. Unsuitable soil is defined in Section 02316 - Excavation and Backfill for Structures and Section 02320 - Utility Backfill Materials.
- D. Complete backfill of new utilities below future grade. Conform to requirements of Sections 02317 - Excavation and Backfill For Utilities and 02511 - Water Mains.

3.03 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other features outside of embankment limits.
- B. Protect utilities above and below grade, which are to remain.
- C. Conform to protection requirements of Section 02315 - Roadway Excavation.

3.04 PLACING EMBANKMENT

- A. Do not conduct placement operations during inclement weather or when existing ground or fill materials exceed 3 percent of optimum moisture content. Contractor may manipulate wet material to facilitate drying, by disking or windrowing.
- B. Do not place embankment fill until density and moisture content of previously placed material comply with specified requirements.

- C. Scarify areas to be filled to a minimum depth of 4 inches to bond existing and new materials. Mix with first fill layer.
- D. Spread fill material evenly, from dumped piles or windrows, into horizontal layers approximately parallel to finished grade. Place to meet specified compacted thickness. Break clods and lumps and mix materials by blading, harrowing, disking or other approved method. Each layer shall extend across full width of fill.
- E. Each layer shall be homogeneous and contain uniform moisture content before compaction. Mix dissimilar abutting materials to prevent abrupt changes in composition of fill.
- F. Layers shall not exceed the following compacted thickness:
 - 1. Areas indicated to be under future paving or shoulders, to be constructed within 6 months: 6 inches when compacted with pneumatic rollers, or 8 inches when compacted with other rollers.
 - 2. Other areas: 12 inches.
- G. For steep slopes, cut benches into slope and scarify before placing fill. Place increasingly wider horizontal layers of specified depth to the level of each bench.
- H. Build embankment layers on back slopes, adjacent to existing roadbeds, to level of old roadbed. Scarify top of old roadbed to minimum depth of 4 inches and recompact with next fill layer.
- I. Construct to lines and grades shown on Drawings.
- J. Remove unsuitable material and excess soil not being used for embankment from the site in accordance with requirements of Section 01576 - Waste Material Disposal.

3.05 COMPACTION

- A. Maintain moisture content of embankment materials to attain required density.
- B. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D 698, unless otherwise indicated on the Drawings:
 - 1. Areas under future paving and shoulders: Minimum density of 95 percent of maximum dry density.
 - 2. Other areas: Minimum density of 90 percent of maximum dry density.

3.06 TOLERANCES

- A. Top of compacted surface: Plus or minus 1/2 inch in cross section or 16 foot length.

3.07 FIELD QUALITY CONTROL

- A. Compaction Testing will be performed in accordance with ASTM D 1556 or ASTM D 2922 and ASTM D 3017 under provisions of Section 01454 - Testing Laboratory Services.
- B. A minimum of three tests will be taken for each 1000 linear feet per lane of roadway or 500 square yards of embankment per lift.
- C. If tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at no cost to the City.

END OF SECTION

Section 02506

POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Polyvinyl chloride pressure pipe for water distribution in nominal diameters 4 inches through 16 inches.
- B. Polyvinyl chloride sewer pipe for gravity sanitary sewers in nominal diameters 4 inches through 48 inches.
- C. Polyvinyl chloride pressure pipe for gravity sanitary sewers and force mains in nominal diameters 4 inches through 36 inches.

1.02 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 Main
- 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- 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 REFERENCES

- A. ANSI A21.5 (AWWA C 105) - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
- B. ANSI A21.10 (AWWA C 110) - Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches for Water and Other Liquids.
- C. ANSI A21.11 (AWWA C 111) - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- D. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
- E. ASTM D 1784 - Standard Specification for Rigid Polyvinyl Chloride Compound and Chlorinated Polyvinyl Chloride Compounds.

- F. ASTM D 2241 - Standard Specification for Polyvinyl Chloride Plastic Pipe (SDR-PR).
- G. ASTM D 2321 - Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- H. ASTM D 2444 - Test Method for 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 Polyvinyl Chloride Composite Sewer Piping.
- J. ASTM D 3034 - Specification for Type PSM Polyvinyl Chloride Sewer Pipe and Fittings.
- K. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- L. ASTM D 3212 - 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 - Specification for Polyvinyl Chloride Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- O. ASTM F 794 - Specification for Polyvinyl Chloride Large-Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- P. ASTM F 949 - Specification for Polyvinyl Chloride Corrugated Sewer Pipe with a Smooth Interior and Fittings.
- Q. AWWA C 900 - Polyvinyl Chloride Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
- R. AWWA C 905 - Polyvinyl Chloride Water Transmission Pipe, Nominal Diameters 14 Inches Through 36 Inches.
- S. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- T. UNI-B-11 - Recommended Standard Specification for Polyvinyl Chloride Water Transmission Pipe (Nominal Diameters 14 Inches through 36 Inches).
- U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.
- 1.04 SUBMITTALS
 - A. Conform to requirements of Section 01300 - 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.

1.05 QUALITY CONTROL

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900 or AWWA C 905 for pressure pipe applications, or the appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that PVC pressure pipe has been hydrostatically tested at the factory in accordance with AWWA C 900 or 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 any other source is not acceptable. Furnish copies of test reports to City Engineer for review. Cost of testing shall be borne by Contractor.

PART 2 PRODUCTS

2.01 MATERIAL

- A. Use PVC compounds in the manufacture of pipe that contain no ingredient in an amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for a rating of 4000 psi for water at 73.4 degrees 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.
- C. For PVC pressure pipe used for water mains, 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.
- D. Gaskets:
 - 1. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
 - 2. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants.

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by the pipe manufacturer

3. Do not use PVC gasket material for water mains in potentially contaminated areas.

E. 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.

F. PVC pipe for water service shall bear National Sanitation Foundation Seal of Approval (NSF-PW).

2.02 WATER SERVICE PIPE

A. Pipe 4-inch through 12-inch: AWWA C 900, Class 150, DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameters.

B. Pipe 16-inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.

C. For large-diameter water mains, provide pipe manufactured by J-M Manufacturing Company, North American, Diamond Plastics Corporation, or I-Pex.

D. Joints: ASTM D 3139; push-on type joints in integral bell or separate sleeve couplings. Do not use socket type or solvent weld type joints.

E. Make curves and bends by deflecting the joints. Do not exceed maximum deflection recommended by the pipe manufacturer. Submit details of other methods of providing curves and bends for review by City Engineer.

F. Hydrostatic Test: AWWA C 900, AWWA C 905, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

2.03 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

A. Bends and Fittings: ANSI A 21.10, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating.

B. Coatings and Linings: Conform to requirements of Section 02501 - Ductile-Iron Pipe and Fittings.

PART 3 EXECUTION

3.01 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with the manufacturer's recommendations.

3.02 INSTALLATION

- A. Conform to requirements of Section 02511 - Water Mains.
- B. Install PVC pipe in accordance with Section 02317 - Excavation and Backfill for Utilities, ASTM D 2321, and manufacturer's recommendations.
- C. Water service pipe 12 inches in diameter and smaller: Installed to clear utility lines and have minimum 4 feet of cover below lowest property line grade of street, unless otherwise required by Drawings.
- D. For water service, exclude use of PVC within 200 feet (along the public right-of-way) of underground storage tanks or in undeveloped commercial acreage. Underground storage tanks are primarily located on service stations but can exist at other commercial establishments.
- E. Avoid imposing strains that will overstress or buckle the pipe when lowering pipe into trench.
- F. Hand shovel pipe bedding under the pipe haunches and along the sides of the pipe barrel and compact to eliminate voids and ensure side support.

END OF SECTION

Section 02511

WATER MAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation of water mains.
- B. Leads for fire hydrant relocation.
- C. Specifications identify requirements for both small-diameter water mains and large-diameter water mains. When specifications for large-diameter water mains differ from those for small-diameter water mains, large-diameter specifications will govern for large-diameter pipe.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for water mains installed by open-cut or augered with or without casing is on a linear foot basis for each size of pipe installed. Separate pay items are used for open-cut and augered installation.
 - a. Mains: Measure along axis of pipe and include fittings and valves.
 - b. Branch Pipe: Measure from axis of main to end of branch.
 - 2. Payment of fire hydrant branch for relocated fire hydrant will be from the center line axis of the existing main or the center line of the existing valve to the center line of the relocated fire hydrant along the center of branch.
 - 3. For large-diameter water mains, payment for an interconnection is on a lump sum basis for each interconnection required. Payment will include tapping sleeve and valves and all other related work necessary for construction as shown on Drawings as specified.
 - 4. For large-diameter water mains, payment for removal of existing internal elliptical or dished head plug is on a lump sum basis for each internal elliptical or dished head plug removed. Payment will include deletion of plug, drainage or dewatering of water lines, repair of damaged linings, rechlorination and all items incidental to operation.
 - 5. When directed by City Engineer to install extra fittings as required to avoid unforeseen obstacles, payment will be based on the following:

- a. Each extra fitting requested by City Engineer and delivered to jobsite will be paid according to the unit price for "Extra Fittings in Place."
 - b. Payment will include and be full compensation for all items necessary for installation and operation of the water line.
6. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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 REFERENCES

- A. ANSI/NSF Standard 61.
- B. ASTM A 126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- C. ASTM B 21 - Specification for Naval Brass Rod, Bar, and Shapes.
- D. ASTM B 98 - Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
- E. ASTM B 584 - Specification for Copper Alloy Sand Castings for General Applications.
- F. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.
- G. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 - Submittal Procedures.
- B. Conform to submittal requirements of applicable Section for type of pipe used.
- C. Photographs: Prior to commencement of construction, take 35mm color photographs of entire route of project and present one copy of prints and negatives to City Engineer. Required items in photographs include, but are not limited to, the following:
 1. Date fixed on negative by calendate attachment in camera (automatically includes date on film).
 2. Location of photograph, house numbers and streets, direction of view, along with project numbers on chalkboard in photo.
 3. Condition of:
 - a. Yard (near side and far side of street).

- b. House walk and sidewalk.
 - c. Curb.
 - d. Area between walk and curb.
 - e. Particular features (yard light, shrubs, fences, trees, etc.).
 - f. Street failures.
4. Take sufficient number of photographs to show existence or nonexistence of cracked concrete, trees, shrubs, and grass required by Paragraph 1.03C.3.c. Bind photographs in 3-ring notebook within plastic pockets. No payment will be made for photography under this Section. Include cost in unit price for water mains.
 5. Job number on chalkboard.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Install pipe materials which conform to following:
 1. Section 02501 - Ductile Iron Pipe and Fittings.
 2. Section 02506 - Polyvinyl Chloride Pipe.
- B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
- C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.

2.02 WELDED JOINT PROTECTION FITTING

- A. Cylindrical Corrosion Barrier manufactured by Heat-Pro Systems, Inc., or approved equal.
- B. O-rings: Conform to National Sanitary Foundation requirements.

2.03 RESTRAINED JOINTS

- A. Ductile-Iron Pipe:
 1. Super-Lock Joint by Clow Corporation.
 2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.

3. TR-Flex or Field-Lok Joint by U.S. Pipe and Foundry Company.

B. PVC Pipe:

1. Fittings: JCM 610 Sur-Grip Fitting Restrainer by JCM Industries, Inc. or Series 500 Fitting Restrainer by Ebba Iron, Inc., or approved equal.
2. Bell and Spigot: JCM 620 or 621 Sur-Grip Bell Joint Restrainer by JCM Industries, Inc. or Series 1500 or Series 1100HV Joint Restrainer by Ebba Iron, Inc., or approved equal.

C. Prestressed Concrete Cylinder Pipe and Steel Pipe: Welded joints (see Paragraph 3.01 G).

2.04 COUPLINGS AND APPURTENANCES FOR LARGE-DIAMETER WATER MAIN

A. Flexible (Dresser-type) Couplings.

1. Install where shown on Drawings or where allowed by City Engineer for Contractor's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene or Buna-N.
2. For steel pipe; sleeve-type flexible couplings, Dresser Style 38, Rockwell Type 411, or equal. Thickness of middle ring equal to or greater than thickness of pipe wall.
3. Flanged adapter couplings for steel pipe; Dresser Style 128, Rockwell Type 913, or approved equal.
4. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of T.C. Mastic as manufactured by the Tape Coat Company, Inc., Bitumastic No. 50 as manufacturer by Koppers Company, Inc., or approved equal.

B. Victaulic Joints. Make joint with Victaulic Style 77 coupling fitted with Grade H molded synthetic rubber gasket.

C. Flap Valves: Provide on discharge of manhole drainline as shown on Drawings.

1. Body and Flap: ASTM A 126-B cast iron.
2. Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.
3. Resilient Seat: Buna-N.
4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.

5. Hinge pins: ASTM B 98-CA655 silicon bronze.
6. Provide Rodney Hunt Series FV-AC, or equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Conform to applicable installation specifications for types of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints. Lay pipe with bell ends facing in direction of laying.
- C. Lay pipe to lines and grades shown on Drawings. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 50 feet on record drawings.
- D. Confirm that separation from gravity sanitary sewers and manholes or from force mains have minimum clearance as specified in this Section or 9 feet in all directions unless a special design is provided on the Drawings:
 1. Parallel water line and gravity sanitary sewer, force main or manhole with no leaks: Minimum 4 foot horizontal clearance from outside wall of water line to outside wall of gravity sanitary sewer, force main, or manhole.
 2. Water line crossing above a gravity sanitary sewer or force main with no leaks: Minimum 2 foot vertical clearance.
- E. Where above clearances cannot be attained, and a special design has not been provided on Drawings, obtain direction from City Engineer before proceeding with construction.
- F. Inform City Engineer if any unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by City Engineer.
- G. Keep pipe trenches free of water which might impair pipe laying operations. Prevent pipe bells from coming in contact with subgrade. Grade pipe trenches to provide uniform support along bottom of pipe. Excavate for bell holes for proper sealing of pipe joints after bottom has been graded and in advance of placing pipe. Lay not more than a nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

- H. City of Tomball will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.
- I. If asbestos-cement pipe is encountered, follow safety practices outlined in the Asbestos-Cement Pipe Producers Association publication, Recommended Work Practices for A/C Pipe. Strictly adhere to recommended practices contained in this publication.
- J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with a unique designation on the inside of the pipe. Minimum letter height is 4 inches.
- K. Laying Large-diameter Water Main
 - 1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
 - 2. Dig trench proper width as shown. When Contractor's operations cause trench width below top of pipe to become 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by City Engineer. No additional payment will be made for higher class of pipe or improved bedding.
 - 3. Prevent damage to coating when placing backfill. Backfill material shall be free of large rocks or stones, or other material which could damage coatings.
 - 4. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation. Groove pipe to manufacturer's specifications.
- 1. Contractor is responsible for assuring the chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for all costs due to downtime if requirements are not met.

3.02 HANDLING, CLEANING AND INSPECTION

A. Handling:

- 1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
- 2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
- 3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.

4. For large-diameter water mains, handle pipe only by means of a sling of canvas, leather, nylon, or similar material. The sling shall be a minimum 36 inches in width. Do not tear or wrinkle tape layers.
 5. Use precautions to prevent injury to pipe, protective linings and coatings.
 - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
 - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
 - c. Do not lift pipe using hooks at each end of pipe.
 - d. Do not place debris, tools, clothing, or other materials on pipe.
 6. Repair damage to pipe or protective lining and coating before final acceptance.
 7. Permit no visible cracks longer than 6 inches, measured within 15 degrees of a line parallel to pipe longitudinal axis in the cores of finished pipe with the following exceptions:
 - a. In the surface laitance of centrifugally cast concrete.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.
- B. **Cleaning:** Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until the Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. **Inspection:** Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.03 EARTHWORK

- A. Conform to applicable provisions of Section 02317 - Excavation and Backfilling for Utilities.
- B. **Bedding:** Use bedding materials in conformance with Section 02320 - Utility Backfill Materials.

- C. Backfill: Use bank run sand or earth or native soil as specified in Section 02320 - Utility Backfill Materials. Backfill excavated areas in the same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
- D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Field density tests may be made at a frequency determined by the City Engineer. Water tamping is not allowed.
- E. Pipe Zone: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

3.04 PIPE CUTTING

- A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by City Engineer. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.05 PIPING INSTALLATION

- A. Do not lay pipe unless subgrade is free of water. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material. Wedging or blocking up bell will not be acceptable.
- B. Do not install pipe at greater depth than its design allows.
- C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

3.06 JOINTS AND JOINTING

- A. Rubber Gasketed Bell-and-Spigot Joints (Concrete Cylinder Pipe, PVC, Steel, and DIP):
 1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
 2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
 3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
 4. After the pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.

5. Where preventing movement of 16-inch-diameter or greater pipe is necessary due to thrust, use restrained joints.
- B. Flanged Joints (Concrete Cylinder Pipe, DIP, Steel):
1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south center line. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
 2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at the factory to proper dimensions.
 3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 4. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrile seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal conforming to ANSI 21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrile seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal conforming to ANSI 21.11 mechanical joint gaskets.
- C. Welded Joints with Protection Fittings:
1. In addition to welding requirements in Paragraph 3.06B, conform to protection fitting manufacturer's installation recommendations.
 2. Provide services of a technical representative of the manufacturer available on site at the beginning of pipe laying operations. Representative shall train welders and advise Contractor and City Engineer regarding installation and general construction methods.
- D. Welded Joints (Concrete Cylinder Pipe, Steel):
1. Prior to starting work, provide certification of qualification for welders employed on the project for type of work procedures and positions involved.
 2. Joints: AWWA C 206. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded

- joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
3. Furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
 4. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1-1/2-inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.
 5. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true, and preserve alignment during welding operation. For butt-welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, care shall be taken to avoid damage to linings and coatings.
 6. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat-resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
 7. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
 8. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
 9. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.
 10. Do not weld under any weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
 11. Make tack weld of same material and by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
 12. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
 13. Welded Joints for Large-diameter Water Mains:
 - a. Furnish pipe with trimmed spigots and interior welds for 36-inch and larger pipe.

- b. Use exterior welds for 30-inch and smaller.
 - c. Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2-1/2 degrees.
 - d. Employ an independent certified testing laboratory, approved by City Engineer, to perform weld acceptance tests on welded joints. Include cost of such testing in contract unit price bid for water line. Furnish copies of all test reports to City Engineer for review. Test by magnetic particle test method for lap welds or by X-ray methods for butt welds, for 100 percent of all joint welds. City Engineer has final decision as to suitability of all welds tested.
- E. Harnessed Joints (Large Diameter Water Mains - Concrete Cylinder Pipe):
- 1. Use of snap-ring type restrained joints on pipe is limited to 16-inch through 48-inch diameters.
 - 2. Position snap-ring joint bolt on top (12 o'clock portion). Provide a minimum 1/2-inch joint recess. Use joint "diapers" a minimum of 12 inches wide.
 - 3. For field adjustments with deflections beyond manufacturer's recommendations:
 - a. Field trim spigot.
 - b. Do not engage ring.
 - 4. Harnessed joints are not permitted in areas defined on Drawings as potentially petroleum contaminated material, in tunnels, or at any bend greater than 5 degrees.
- F. Joint Grout (Concrete Cylinder Pipe, Steel):
- 1. Mix grout by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Use grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
 - 2. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without retempering. Use grout for filling grooves of such consistency that it will adhere to ends of pipe.
 - 3. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
 - 4. Follow established procedures for hot and cold weather concrete placement.

5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.
6. Grouting exterior joint space: Use minimum 9-inch-wide Ethafoam "diaper" or wrapper placed around pipe and over joint. Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of the joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with a structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
7. Interior Joints for Pipe Smaller than 24 Inches: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use a swab approved by City Engineer for 20-inch pipe and smaller.
8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if the joint bands are protected by zinc metallizing or other approved protective coatings.
9. Remove and replace improperly cured or otherwise defective grout.
10. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply flexible sealer, such as Flex Protex by Gifford-Hill America, or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.
11. Interior Joints for Large-diameter Water Mains:
 - a. Pipe 30 inches and 24 inches: Circumferentially butter bell with grout using hand trowel as described in Paragraph 3.06E.7.
 - b. Pipe 36 inches and larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe. Accomplish grouting at end of each work day. Obtain written acceptance from City Engineer of inside joints before proceeding with next day's pipe laying operation.

G. Joint Testing:

1. In addition to testing individual joints with feeler gauge approximately 1/2-inch wide and 0.015-inch thick, use any other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. These tests shall be made at no additional cost to City.
2. Test 100 percent of welded joints including any joint or seam welded after successful hydrostatic testing by methods as described in Paragraph 3.06C, Welded Joints. City reserves right to require additional tests if tests performed indicate an unacceptable weld. Repair rejected weld.

H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by the City Engineer. Contractor may submit details of other methods of providing curves and bends for consideration by City Engineer, and if accepted, shall be installed at no additional cost to the City.

1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
4. Replace, repair, or reapply coatings and linings as required.
5. Assessment of deflection may be measured by City Engineer at any location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
6. When rubber gasketed pipe is laid on a curve, join pipe in a straight alignment and then deflect to curved alignment.

I. Closures and Field Modifications to Steel, Concrete Cylinder Pipe, and Fittings: These requirements also apply to standard pipe joints which exceed manufacturer's recommended deflection.

1. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.
2. Fill exposed interior and exterior surfaces with nonshrink grout.

3. For large-diameter water mains, perform field welds on interior and exterior of pipe.
4. For large-diameter water mains, provide minimum overlap of 2 inches of butt strap over adjacent piece on butt-strap closures.

3.07 CATHODIC PROTECTION APPURTENANCES

- A. Where identified on Drawings, modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water main, access manhole piping and other major openings in water main, or as shown on Drawings.
- B. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint. No additional bonding required where joints are welded for thrust restraint.
- C. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

3.08 SECURING, SUPPORTING AND ANCHORING

- A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.
- B. Where shown on Drawings, anchor pipe fittings and bends installed on water main by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begin upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
- C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.09 THRUST RESTRAINT

- A. For new water lines 16 inches in diameter and larger, restrain joints as specified in Paragraph 3.06A.5 of this Section.
- B. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in Paragraph 3.06A.5 of this Section.

- C. Prevent any lateral movement of thrust restraints throughout pressure testing and operation. Place 2500 psi concrete conforming to Section 03315 - Concrete for Utility Construction, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.
 - D. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of prestressed concrete cylinder pipe. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer for review by City Engineer. Make adjustments in thrust restraint lengths at no additional cost to the City.
 - E. Passive resistance of soil will not be permitted in calculation of thrust restraint.
 - F. Use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide welded restraint joints for a minimum length of 16 feet on each side of beveled joints.
- 3.10 POLYETHYLENE WRAP
- A. Double wrap pipe and appurtenances (except fire hydrants) with 8-mil polyethylene film.
 - B. Conform to requirements of Section 02528 - Polyethylene Wrap.
- 3.11 CLEANUP AND RESTORATION
- A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during chlorination, testing, service transfers, abandonment of old mains, backfill and surface restoration.
 - B. Upon completion of section not exceeding 4000 feet per crew, chlorinate and pressure test. Begin transfer of services no later than 7 calendar days after successful completion of chlorination and pressure testing.
 - C. After transfer of services, but no later than 21 calendar days after successful completion of chlorination and pressure testing, begin abandonment of old mains, including resodding and placement of sidewalks and pavements.
 - D. Do not begin construction of additional sections if above conditions are not met.
 - E. For large-diameter water mains, do not install more than 2000 feet of main, without the previous 2000 feet being cleaned up and site fully restored. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1000 feet. Failure to comply with this requirement will result in a "Notice of Nonconformance".

3.12 CLEANING PIPING SYSTEMS

- A. Remove construction debris or foreign material and thoroughly clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning.

3.13 DISINFECTION OF WATER LINES

- A. Conform to requirements of Section 02514 - Disinfection of Water lines.

3.14 FIELD HYDROSTATIC TESTS

- A. Conform to requirements of Section 02515 - Hydrostatic Testing of Pipelines.

END OF SECTION

Section 02514

DISINFECTION OF WATER LINES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disinfection of potable water lines.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for disinfection of water lines under this Section. Include cost in unit price of water lines being disinfected.
2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Adjusting Payment for Retesting.

1. Subsequent disinfection operations which may be necessary due to nonconforming or incomplete construction will be charged to Contractor. Charges will be deducted from retainage amounts when construction estimates are processed for final payment.
2. Total charge will consist of base charge of \$135.00 plus footage charge based on number of feet of specified diameter pipe in construction project. Footage charge is as follows:

<u>Size of Pipe</u>	<u>Charge per Linear Foot</u>
2-inch to 4-inch	\$0.03
6-inch	0.04
8-inch	0.05
10-inch to 12-inch	0.07
16-inch to 20-inch	0.09
24-inch to 30-inch	0.13
32-inch to 48-inch	0.16
54-inch	0.20
60-inch	0.22
66-inch	0.31
72-inch to 84-inch	0.40
90-inch to 96-inch	0.58
108-inch	0.75
120-inch or larger	1.00

- C. 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 REFERENCES

- A. AWWA C 651 - Disinfecting Water Mains.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 CONDUCTING DISINFECTION

- A. Water lines constructed shall be promptly disinfected before any tests are conducted on water lines and before water lines are connected to City water distribution system.
- B. Water for disinfection and flushing will be furnished by City without charge.
- C. Unless otherwise provided in Contract Documents, City will conduct disinfection operations assisted by Contractor.
- D. Coordinate chlorination operations through Owner.

3.02 PREPARATION

- A. Use required temporary blind flanges, cast-iron sleeves, plugs, and other items needed to facilitate disinfection of new mains prior to connection to City water distribution system. Normally, each valved section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.
- B. Fire hydrants shall be used as blow-offs to flush newly constructed water lines 8-inch diameter and above. Where fire hydrants are not available on water lines, locations and designs for blow-offs shall be as indicated on Drawings. Install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in a manner approved by City Engineer. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.
- D. Excavations shall be backfilled immediately after installation of risers or blow-offs.
- E. Install blow-off valves at end of main to facilitate flushing of dead-end water mains. Install permanent blow-off valves according to Drawings.

3.03 DISINFECTION BY CITY PERSONNEL

- A. Correct problems that may prevent disinfection operations prior to advising Owner to perform disinfection work. When disinfection work cannot be performed due to covered up valves, missing valve stacks, inoperative fire hydrants or other nonconforming construction, a charge will be levied against Contractor for each trip made by City personnel.
- B. Notify and coordinate with Owner a minimum of 48 hours before disinfection work is to be performed. Assist City personnel during disinfection operations.

3.04 DISINFECTION BY CONTRACTOR

- A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:
 - 1. Use not less than 100 parts of chlorine per million parts of water.
 - 2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
 - 3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
 - 4. Open and close valves in lines being sterilized several times during contact period.
 - 5. If a chemical compound is used for a sterilizing agent, it shall be placed in pipes as directed by City Engineer.

3.03 BACTERIOLOGICAL TESTING

- A. After disinfection and flushing of water lines, bacteriological tests will be performed by City or testing laboratory in accordance with Section 01454 - Testing Laboratory Services. If test results indicate need for additional disinfection of water lines based upon Texas Department of Health requirements, assist City with additional disinfection operations.

3.06 COMPLETION

- A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

Section 02515

HYDROSTATIC TESTING OF PIPELINES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field hydrostatic testing of newly installed water pipelines.
- B. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) water mains and large-diameter (greater than 20 inches) water mains. When specifications for large-diameter water mains differ from those for small-diameter water mains, paragraphs for large-diameter mains will govern for large-diameter pipe.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.
 - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Disinfect water system pipelines prior to hydrostatic testing.
- B. Hydrostatically test newly installed water pipelines after disinfection, if required, and before connecting to City water distribution system.
- C. Water for testing will be charged to Contractor in accordance with City Ordinances. Prior to hydrostatic testing, Contractor's meter shall be tested and approved by the City Engineer.
- D. For large-diameter water mains, test pipelines in lengths between valves, or plugs, of not more than 4400 feet.

- E. Small-diameter pipelines shall be tested in lengths between valves, or plugs, of not more than 1500 feet.
- F. Conduct hydrostatic tests in presence of Owner.

3.02 TEST PROCEDURES

- A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.
- B. Allow pipeline to sit a minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.
- C. For small-diameter pipelines, expel air and apply a minimum test pressure of 125 psi. For large-diameter water mains, expel air and apply a minimum test pressure of 150 psi.
- D. Begin test by 9:00 a.m. unless otherwise approved by City Engineer. Maintain test pressure for 8 hours. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.
- E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.03 ALLOWABLE LEAKAGE FOR WATER MAINS

- A. During hydrostatic tests, no leakage will be allowed for sections of water mains consisting of welded joints.
- B. Maximum allowable leakage for water mains with rubber gasketed joints: 10.63 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at 125 psi or 11.65 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at 150 psi.

3.04 CORRECTION FOR FAILED TESTS

- A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
- B. City Engineer may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Section 02514 - Disinfection of Water Lines. Contractor shall pay for water required for additional disinfection and retesting.
- C. Repeat test until satisfactory results are obtained.

3.05 COMPLETION

- A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

Section 02520

FIRE HYDRANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire hydrants.
- B. Adjustment of fire hydrants and gate valves.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment is on a lump sum basis for each fire hydrant installed.
 - 2. Payment for fire hydrant branches (leads) is on a linear foot basis for each branch installed. Separate pay items are used for open-cut and augered branches.
 - 3. Payment for salvaged fire hydrants is on a lump sum basis for each fire hydrant salvaged.
 - 4. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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 01300 - Submittal Procedures.
- B. Submit name of hydrant manufacturer, type of bonnet paint, and engineering control drawing number for hydrant proposed for use.

PART 2 PRODUCTS

2.01 HYDRANTS

- A. The following fire hydrants have been approved. Alternate fire hydrants will not be considered.

Centurion A423 Option 110 (Super Centurion 250)
Metropolitan 250
Clow - 5 1/4" Medallion
American Darling B84B
Waterous - Pacer WB67HOU
Kennedy - Guardian K81A

- B. The City Engineer may, at any time prior to or during installation of hydrants, randomly select a furnished hydrant for disassembly and laboratory inspection, at City expense, to verify compliance with Specifications. If such hydrant is found to be non-compliant, replace, at Contractor's expense, hydrants, with hydrants that comply with Specifications.

2.02 LEADS

- A. Branches (Leads): Conform to requirements of Section 02501 - Ductile-Iron Pipe and Fittings and Section 02506 - PVC Pipe.

2.03 PAINT

- A. Bonnet Paint: Apply finish coat of Silicone Alkyd Resin Enamel, Acro Products No. 2215, or approved equal meeting SSPC Paint Specification No. 21. Total dry film thickness (DFT): 2 to 3 mils. Exception: Hydrant bonnet shall not be finish shop coated; only intermediate coated. Finish coating shall be field-applied and color-coded when installed.
- B. Provide in colors specified in Paragraph 3.01I to designate size of water supply main.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place a 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete.
- B. Locate nozzle center line minimum 18 inches above finish grade.
- C. Place 12-inch x 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by City Engineer) on pumper nozzles of new or relocated fire hydrants installed on new mains not in service. Remove indicators after new main is tested and approved by City Engineer.

- D. Do not cover drain ports when placing concrete thrust block.
- E. Obtain City Engineer's approval in writing prior to installation of hydrants which require changes in bury depth due to obstructions not shown on Drawings. Unit price adjustments will not be allowed for changes in water main flow line or fire hydrant barrel length caused by such obstructions.
- F. Plug branch lines to valves and fire hydrants shown on Drawings to be removed. Deliver fire hydrants designated for salvage to the nearest Utility Maintenance Quadrant Facility.
- G. Install branches (leads) in accordance with Section 02511 - Water Mains.
- H. Coating Requirements:
 - 1. Apply coatings in strict accordance with manufacturers' recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.
 - 2. Furnish an affidavit of compliance that coatings furnished comply with requirements of this specification and referenced standards, as applicable.
- I. Use following color code for field coating of hydrant bonnet to indicate size of water main supplying hydrant:

<u>Supply Main Diameter (inches)</u>	<u>Bonnet Color</u>
6	Yellow
8	White
12-20	Green
24 and larger	Orange

- J. Salvaged fire hydrants, including removing hydrant and valve if available. Take salvaged fire hydrants to the Utility Maintenance Facility nearest the project.
- K. Remove and dispose of unsuitable materials and debris in accordance with requirements of Section 01576 - Waste Material Disposal.

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. Payment for installation of force main pipe by open-cut, augered with or without casing, or within limits of Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis. Measurement will be taken along center line of pipe from end to end. Payment will be made for each foot of force main installed, complete in place including pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes, acceptance testing, and pipe and accessories.
2. Payment for installation of force main pipe at a bayou crossing is on a lump sum basis.
3. The Unit Price item identifies line segments between stations as shown on Drawings.
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 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

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 - Cast Fiberglass 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. Filament-wound Fiberglass Pipe
 - a. Provide dual-angle, filament-wound fiberglass reinforced epoxy pipe with integral epoxy liner and exterior coating in sizes from 4-inch to 16-inch diameter. Conform to requirements of ASTM D 2310 or ASTM D 2996, depending on size and class of pipe required.

- b. Fiberglass pipe shall have resin rich liner of following thickness:
 - (1) For nominal sizes 4 inches through 6 inches, conform to ASTM D 2310 RTRP 11CX and ASTM D 2996 RTRP 11CX 5430, with minimum liner thickness of 0.020 inch.
 - (2) For nominal sizes 8 inches through 16 inches, conform to ASTM D 2310 RTRP 11FX and ASTM D 2996 RTRP 11FX 3210, with minimum liner thickness of 0.025 inch.
 - (3) The coefficient of linear thermal expansion shall be 8.5×10^{-6} inch/inch/degrees F for 4-inch through 6-inch pipe and 12.0×10^{-6} inch/inch/degrees F for 8-inch through 16-inch pipe in accordance with ASTM D 696.
- c. Hydrostatic design value shall be not less than 21,000 psi when tested in accordance with ASTM D 2992(B) and not less than 8000 psi when tested according to ASTM D 2992(A).
- d. Burial depths for pipes with standard wall thickness shall be between 3 feet and 25 feet.
- e. Joints: Heavy duty threaded coupling system with positive o-ring seals. For 4-inch through 6-inch diameters, provide mechanical joints with fast advance, acme-type threads. Male threaded portion of couplings shall lock mechanical joints for couplings for pipe diameters of 8 inches through 16 inches. Axial movement of couplings shall allow up to 2 degrees of angular deflection without affecting o-ring seal integrity.
- f. Fittings may be contact molded, compression molded, filament wound, or mitered. Fitting must also be capable of withstanding test pressures.
- g. Pipes, fittings, and other components in this system shall be rated for service to 150 psig at 120 degrees F. Components shall be rated at or above design pressure of system.

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: $L = (S) (D) (P) / 133,200 \cdot 0.5$ Where: L = Leakage in gallons per hour. 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 02754

CONCRETE DRIVEWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Portland cement concrete driveways.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for concrete driveways is on square yard basis.
 - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: Conform to material and proportion requirements for concrete of Section 02751 - Concrete Paving.
- B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Section 02751 - Concrete Paving.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Section 02752 - Concrete Pavement Joints.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Section 02752 - Concrete Pavement Joints.
- E. Subgrade Materials: Conform to subgrade material requirements of Section 02336 - Lime Stabilized Subgrade.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prepare subgrade in accordance with applicable portions of Section 02336 - Lime Stabilized Subgrade.

3.02 PLACEMENT

- A. Place and finish concrete in accordance with applicable portions of Section 02751 - Concrete Paving.

3.03 JOINTS

- A. Install joints in concrete driveway in accordance with Section 02752 - Concrete Pavement Joints.

3.04 CONCRETE CURING

- A. Cure concrete driveway in accordance with Section 02753 - Concrete Pavement Curing.

3.05 PROTECTION

- A. Conform to applicable requirements of Section 02753 - Concrete Pavement Curing.

END OF SECTION

Section 02911

TOPSOIL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for topsoil under this Section. Include payment in Section 02921 - Hydromulch Seeding or Section 02922 - Sodding.
 - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having the following characteristics:
 - 1. pH value of between 5.5 and 6.5
 - 2. Liquid limit: 50 or less
 - 3. Plasticity index: 20 or less.
 - 4. Gradation: maximum of 10 percent passing the No. 200 sieve.
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum depth of 4 inches and has similar characteristics to that found at the placement site. Do not obtain topsoil from areas infected with a growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavation and embankment operations have been completed to correct lines and grades.

3.02 TOPSOIL EXCAVATION

- A. Conform to excavation and stockpiling requirements of Section 02315 - Roadway Excavation.

3.03 PLACEMENT

- A. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of 4 inches, or as indicated on the Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with an appropriate lawn roller to consolidate topsoil.
- B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Section 02320 - Utility Backfill Material.
- C. For areas to receive shrubs or trees, excavate existing material and place topsoil to the depth and dimensions shown on the Drawings.
- D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01576 - Waste Material Disposal.

3.04 PROTECTION

- A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

Section 02921

HYDROMULCH SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for hydromulch seeding is on a square yard basis.
 - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- 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 SUBMITTAL

- A. Submittals shall conform to requirements of Section 01300 - Submittal Procedures.
- B. Submit certification from supplier that each type of seed conforms to these specifications and the requirements of the Texas Seed Law. Certification shall accompany seed delivery.
- C. Submit a certificate stating that fertilizer complies with these specifications and the requirements of the Texas Fertilizer Law.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Conform to material requirements of Section 02911 - Topsoil.
- B. Seed: Conform to U.S. Department of Agriculture rules and regulations of the Federal Seed Act and the Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet the following requirements:
 - 1. Rye: Fresh, clean, Italian rye grass seed (*lollium multi-florum*), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.

2. Bermuda: Extra-fancy, treated, lawn type common bermuda (*Cynodon dactylon*). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.
3. Wet, moldy, or otherwise damaged seed will not be accepted.
4. Seed requirements, application rates, and planting dates are:

TYPE	APPLICATION RATE POUNDS/A	PLANTING DATE
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	
Annual Rye Grass (Gulf)	30	

C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear the manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of the following elements:

1. Nitrogen: 10 Percent
2. Phosphoric Acid: 20 Percent
3. Potash: 10 Percent

D. Mulch:

1. Virgin wood cellulose fibers from whole wood chips having a minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter.
2. Cellulose fibers manufactured from recycled newspaper and meeting the same fiber content and size as for cellulose fibers from wood chips.
3. Mulch shall be dyed green for coverage verification purposes.

E. Soil Stabilizer: "Terra Tack 1" or approved equal.

F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Place and compact topsoil in accordance with requirements of Section 02911 - Topsoil.
- B. Dispose of Objectionable and Waste Materials in accordance with Section 01576 - Waste Material Disposal.

3.02 APPLICATION

- A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.
- B. Fertilizer: Apply uniformly at a rate of 500 pounds per acre.
- C. Mulch: Apply uniformly at a rate of 50 pounds per 1000 square feet.
- D. Soil Stabilizer: Apply uniformly at a rate of 40 pounds per acre.
- E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydromulching.
- F. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain City Engineer approval before resuming operations.

3.03 MAINTENANCE

- A. Maintain grassed areas a minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in the fall, continue maintenance the following spring until an acceptable lawn is established.
- B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.
- C. Repair areas damaged by erosion by regrading, rolling and replanting.

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 the services of and pay for a 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 the Contract is a Stipulated Price Contract, payment for work in this Section is included in the 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 - Batch Plant Inspection and Field Testing of Ready Mixed Concrete.
- H. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete.

- 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) Bars for Concrete Reinforcement.
- O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- P. ASTM A 820 - 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 Method of 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.
- AB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

- AC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - AD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
 - AE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
 - AF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
 - AG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
 - AH. ASTM C 1017 - Chemical Admixtures for Use in Producing Flowing Concrete.
 - AI. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
 - AJ. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
 - AK. ASTM D 638 - Test Method for Tensile Properties of Plastics.
 - AL. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - AM. ASTM D 747 - Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
 - AN. CRSI MSP-1 - Manual of Standard Practice.
 - AO. CRSI - Placing Reinforcing Bars.
 - AP. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
 - AQ. NRMCA - Concrete Plant Standards.
- 1.04 SUBMITTALS
- A. Conform to Section 01300 - Submittal Procedures.
 - B. Submit proposed mix design and test data for each type and strength of concrete in the Work.
 - C. Submit laboratory reports prepared by an 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 the City Engineer.
- 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.

1.06 HANDLING AND STORAGE

- A. Cement: Store cement off of the ground in a 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 the coating.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cementitious Material:
 - 1. Portland Cement: ASTM C 150, Type II, unless the use of Type III is authorized by the City Engineer; 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 the form of $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$.
- 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 the following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of the 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 the potential reactivity of fine and coarse aggregate in accordance with the 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 the 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 an 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 FORMWORK 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 the 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. Formwork 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 the 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 a 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 a 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 a 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 the City Engineer for review.
- C. Proportioning on the basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, if approved by the City Engineer.

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 the 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 the Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.06 PVC WATERSTOPS

- A. Extrude from virgin polyvinyl chloride elastomer. Do not use reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the 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 the Drawings; either a 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 a 2-part protective paper.
4. Submit independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.
5. Provide primer, to be used on hardened concrete surfaces, from the same manufacturer who supplies the 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 the 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 cleanout 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 formwork with a sufficient number of studs and wales to prevent deflection.
- E. Re-oil or lacquer the liner on the 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 City Engineer, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before the 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 the City Engineer 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 the 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 the City Engineer. 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 an 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 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the City Engineer before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to the site shall be accompanied by batch tickets providing the information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing the 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 the shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until the concrete has cured for a 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 the City Engineer.

3.05 PLACING CONCRETE

- A. Give sufficient advance notice to the City Engineer (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 the City Engineer's approval.
- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, if necessary to continue after daylight hours, light the site as required. If rainfall occurs after placing operations are started, provide covering to protect the 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 an initial set; do not place any 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 the size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move the vibrator vertically through the 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 the extent of the joint; make splices necessary to provide such 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 the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.
- C. Splicing PVC Waterstops:
 - 1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.
 - 2. Butt end-to-end joints of two identical waterstop sections may be made in the forms during placement of waterstop material.
 - 3. Prior to placement in formwork, prefabricate waterstop joints involving more than two ends to be joined together, an angle cut, an alignment change, or the joining of two dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the City Engineer, install prefabricated waterstop joint assemblies in formwork, and butt-

weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.

D. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete and to prevent folding over of the 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 a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the 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 to the Specifications.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
2. When requested by the City Engineer, provide technical assistance by manufacturer's representative in the field at no additional cost to the 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 a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.
5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.
6. Bentonite Waterstop:
 - a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the 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 the 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 if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.
- e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.

7. Adhesive Waterstop:

- a. With a wire brush thoroughly clean the concrete surface on which the waterstop is to be placed and then coat with primer.
- b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.
- c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with protective paper.
- d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the 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 City Engineer. 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 a 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 the concrete surface after placing and finishing. A curing day is any calendar day in which the temperature is above 50 degrees F for at least 19 hours. Colder days may be counted if 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 the end of calendar days equal to twice the required number of curing days. However, leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the City Engineer.
- B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for the full curing period. Keep wood forms wet during the 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 the 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 a final finish and surplus water sheen has disappeared, immediately seal surface with a uniform coating of approved curing compound, applied at the rate of coverage recommended by manufacturer or as directed by the City Engineer. 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 the compound.
2. Thoroughly agitate the 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 a dry surface. If concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or if rain falls on a newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound at the 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 the 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 the specified 28-day strength, unless directed otherwise by the City Engineer.

3.10 DEFECTIVE WORK

- A. Immediately repair any defective work discovered after forms have been removed. If concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace the 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 a 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 the surface.
- B. Apply a rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet the surface with a 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 a 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 the surface to reset; then wash surface with clean water. Leave structure with a clean, neat and uniform-appearing finish.

- C. Apply a 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 City Engineer, the following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by an approved independent testing agency, and conform to the 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 the 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.
- D. Testing High Early Strength Concrete: When Type III cement is used in concrete, the specified 7-day and 28-day compressive strengths shall be applicable at 3 and 7 days, respectively.
- E. 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. If additional curing fails to produce the required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by the City Engineer, at no additional cost to the City.

3.13 PROTECTION

- A. Protect concrete against damage until final acceptance by the City.

- 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 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 City Engineer.

END OF SECTION

SPECIFICATION WP-201

GRAVEL WALL WATER WELL

- 1.01 **SCOPE OF WORK:** The work covered under this section consists of furnishing all labor, materials, transportation, tools, supplies, equipment and appurtenances, and the performance of all operations required to provide the OWNER with a gravel wall water well, complete with all equipment as specified.
- 2.01 **MATERIAL QUALITY:** All material used in the well shall be in accordance with the latest standards or specifications of the Texas Commission on Environmental Quality, American Water Works Association, the American Society of Testing and Materials, the American Petroleum Institute and the American Welding Society as applicable to this project. The material shall be new and of the best grade and quality. When two or more pieces of the same material or equipment are required, these pieces shall be standard catalog products of a single manufacturer unless authority is obtained from the Owner or Engineer to use different materials or equipment.
- 3.01 **PROTECTION OF SITE:** The CONTRACTOR shall protect all structures, walks, underground utilities, trees and shrubbery during the progress of work. Water pumped from the well shall be disposed of as approved by the ENGINEER and so as not to damage the site or adjacent property. Mud pits will not be permitted on the site. Upon completion of the work, the CONTRACTOR shall remove all cuttings, drilling debris and unused materials and shall restore the site as nearly as possible to its original condition to the satisfaction of the ENGINEER.

The premises, materials, tools, and drilling equipment shall be maintained so as to minimize contamination of the groundwater during drilling operation. Water used in any drilling operation shall be of safe sanitary quality. Water used in the mixing of drilling fluids or mud shall contain a chlorine residual of at least 0.5 milligrams per liter (mg/L). The slush pit shall be constructed and maintained so as to minimize contamination of the drilling mud. No temporary toilet facilities shall be maintained within 150 feet of the well being constructed unless they are of a sealed, leakproof type.

- 4.01 **DIMENSION AND QUANTITY CONDITIONS:** The well shall be constructed on a site furnished and staked by the Owner. The following dimensions and approximate material quantities shall apply:

	BASE BID
Pilot Hole Depth	950'
Pilot Hole Diameter	7-5/8" to 9-7/8"
Well Completion Depth	850'
Surface Casing Size	24" O.D.
Depth of Surface Casing	550'
Blank Liner Production Casing Size	18" O.D.

Amount of Blank Lining	200 V.F.
Amount of Screen	100 V.F.
Screen Material	Pipe-Base Stainless Steel, Wire-Wrapped Screen on Steel Pipe with round drilled holes
Screen Diameter	18" O.D.
Diameter of Underreaming	28"
Production Guarantee	1,500 GPM

5.01 PILOT HOLE:

- A. Pilot Hole: A pilot hole not less than 7-5/8" and not more than 9-7/8" shall be drilled to a base depth of 950 feet or to another depth determined by the Owner. The purpose of the pilot hole is to obtain hydrological information concerning the sub-surface formation at the site, and for construction of a water well at the site.
- B. Driller's Log: During the drilling of the pilot hole, a detailed driller's log shall be kept of all formations encountered, giving complete descriptions of all formations. The datum for the recorded depths shall be ground level.
- C. Drilling Mud: Drilling mud shall consist of premium grade, western-sodium bentonite, Quick-Gel viscosifier, as manufactured by Baroid Drilling Fluids Products, or approved equal, and non-fermenting, inorganic polymer, Pac, as manufactured by Baroid Drilling Fluids Products, or approved equal, mixed with potable water and containing no caustics or toxic additives detrimental for use in potable water wells. Soda-ash shall be used in sufficient quantity to neutralize the mud and maintain a pH range of 7.0 to 8.0 for optimum mud yield. On site mixing of the drilling mud shall be accomplished in the mud tanks through a jet/hopper mixer utilizing the mud pump for circulation.
- D. Mud Control and Testing: A record of the types and amounts of drilling mud or mud additives added during each tour and the times at which it is added shall be recorded on each tour progress report. The Contractor shall maintain laboratory equipment for the control of drilling mud during all drilling operations. Mud weight, viscosity, water loss, pH, and sand content shall be measured and recorded at least twice during each tour. These tests shall be run in accordance with the American Petroleum Institute Specifications (Code RP-29) for drilling mud testing. The Contractor shall control the mud characteristics so development of the well is obtained.
- E. Sieve Analyses of Drill Cuttings: The Contractor shall have standard sieve analysis run on all drill cutting samples of water-bearing sands obtained from the pilot hole. Contractor shall determine effective size, uniformity coefficient, and model size. Prior to the making of the analysis, the Contractor shall obtain approval by the Engineer of the laboratory and method and sieve sizes selected for the analysis. Three copies of the results shall be furnished to the Engineer.
Collect drill cutting samples from all potential water-bearings formations. Drill cutting samples shall be collected at intervals of no more than 10 feet from all sand

sections encountered in the hole below the depth of 200 feet. Three portions, about one-half to one pint each, of each sample taken shall be preserved in cloth sample bags marked as to depth and well number. One set of samples shall be retained on the job for inspection. The Contractor shall deliver one set of samples to the Engineer. The third set of samples shall be retained by the Contractor for sieve analysis.

- F. Single Shot Alignment: Readings shall be taken with a Baker Hughes INTEQ mechanical drift indicator in the pilot hole at vertical intervals of approximately thirty (30) feet of depth to the total depth of the hole. If any reading taken indicates a deflection of the hole from vertical of 45 minutes or more, the Contractor shall correct the alignment so that the deflection from vertical is less than three fourths (3/4) degree of one degree or abandon and plug the pilot hole and drill at his own expense another pilot hole.

The mechanical drift indicator disks shall be made available to the Engineer during the course of the work. In case of disagreement between the Contractor and the Owner as to the mechanical drift indicator interpretations, the mechanical drift indicator disks shall be analyzed by INTEQ and two (2) copies of INTEQ's interpretation of the survey shall be supplied to the Engineer. A full set of originals or exact copies of the disks, with their depths, shall be delivered to the Engineer with the Contractor's report provided for in these specifications.

- G. Geophysical Logs: When the pilot hole has been drilled to a depth as indicated in Section 4.0 or to another depth determined by the Engineer and the Owner, a Baker Hughes/Baker Atlas High Definition Induction Log with Gamma Ray Log, spontaneous potential, a Compensated Z-Densilog Compensated Neutron Log and optional Spectralog shall be made in the hole. When the required depth is reached, circulation shall continue until all drill cuttings have been removed from the hole, and the drilling mud in the hole is uniform and the logging service equipment is on location, the drill pipe may be removed from the hole. The logs shall be made immediately following removal of the drill pipe from the pilot hole. The Contractor shall select the scales of the logs. Eight copies of the electric log shall be submitted to the Owner upon completion of the logging procedure for his records.

The professional logging analyst shall provide their written analysis in a letter to the Contractor and Owner regarding review of the geophysical logs and any natural radioactivity, natural gas and any other concerns for completion of a public water supply well in the pilot hole. If natural gas is encountered in the well in such quantities that in the opinion of the Engineer, special construction techniques or equipment are necessary to control it, and/or in the opinion of the Engineer the gas will prevent the specific capacity from being met, the Owner may at his option authorize charge for extra work to control the gas, all as the Owner considers to be reasonable. Any such decision by the Owner must be in writing and the Contractor shall be bound by it.

- H. Chemical Analyses of Water: The contractor shall have a complete standard water analysis made of three samples of the water by a laboratory acceptable to the Texas

Commission on Environmental Quality (TCEQ) at depths specified by the engineer. At the option of the Owner and Engineer, the Engineer may specify one or more depth intervals from which water samples will be collected and analyzed as included in the supplemental unit price items. The contractor shall have a qualified laboratory and lab personnel, approved by the Owner or Engineer, collect the required samples from the pilot hole near the end of the pilot hole submersible pumping period and perform complete analyses for the primary and secondary constituents listed in the latest version of TCEQ Chapter 290 Subchapter F, including radionuclides, in addition to a gas analysis. The field turbidity shall be 5 ntu or less prior to collecting the pilot hole water samples. Contractor personnel shall not be allowed to collect the water samples, only lab personnel. The complete costs of the water sampling operation shall be paid for by the contractor. The results of the analysis shall be furnished to the engineer and owner for review. In addition two, one-gallon water samples shall be collected during the submersible pumping period and delivered to the Owner.

- I. Contractor's Evaluation: After completion of the pilot hole according to and meeting all these specifications, the Contractor shall present a written report to the Owner giving his recommendations for satisfactory completion of a water well meeting these specifications and the required guarantees. The report shall include the sieve analysis of the formation samples, the chemical analysis of any water samples taken, the material settings recommended by the Contractor, the size of the screen recommended by the Contractor, the size of the screen openings that has been selected by the Contractor based on the character and sieve analysis of the formation samples, and the type and grading of gravel that the Contractor has selected for the well.
- J. Evaluation of Pilot Hole: Based on the results of the pilot hole, and within seven days after receiving the Contractor's complete written recommendations, the Engineer and Owner will decide whether a well will be completed in the pilot hole, and if the decision is favorable, the Engineer will select the depth to which the surface casing shall be set and the depths and lengths of the blank liner and screen in the liner. If the Engineer's selections differ from the Contractor's recommended material settings and if the Contractor objects to the Engineer's selections, the Contractor shall immediately present to the Owner, in writing, his objections and reasons and shall discontinue work on the well until a decision is reached in this regard. Otherwise, the Contractor shall construct the production well in the pilot hole, meeting all the provisions and guarantees of these specifications and other contract documents.
- K. Abandonment of Pilot Hole: If the water well fails to conform to these specifications and the conditions cannot be corrected, the well may be plugged and abandoned. If the failure of the well is due to Contractor error, payment for the well may not be made. If the pilot hole is not usable due to natural problems encountered, the Contractor will be paid for the pilot hole work completed. At the direction of the Engineer, the contractor shall plug and abandon the pilot hole as follows:
 - 1. Salvage as much casing and screen as possible from the pilot hole.
 - 2. Plug the pilot hole with heavy drilling mud and cement as directed by the Owner using materials and methods that meet TDLR, TCEQ, and the Harris Galveston Subsidence District requirements.

3. Cut off any casing remaining in the pilot hole at least five feet below ground surface. Fill the remaining five feet with native topsoil.

L. Plugging of Pilot Hole Below Bottom of Well: If the pilot hole has been drilled appreciably deeper than the total depth selected for the water well, the Owner may require that the pilot hole immediately below the bottom of the proposed water well shall be plugged with Portland cement. The placement of the cement plug shall be by pumping a cement slurry weighing approximately 15 pounds per gallon through the drill pipe into the hole at the depth directed by the Owner. The cement plug shall contain 30 sacks of cement unless a different quantity is approved by Owner. The cement plug shall be tested before the pilot hole is reamed by placing at least 6,000 pounds of the weight of the drill pipe on top of the plug. The Contractor will be allowed to conduct reaming operations for setting the surface casing in the hole during the cement setting time. The drilling fluid shall be treated to eliminate all cement contamination from the drilling mud prior to beginning any drilling operations after placing the cement plug.

6.01 WELL CONSTRUCTION

- A. General: Based on the results of the pilot hole, and within seven days after receiving the Contractor's complete written recommendations, the Engineer and Owner will decide whether a well will be completed in the pilot hole, and if the decision is favorable, the Engineer will select the depth to which the surface casing shall be set and the depths and lengths of the blank liner and screen in the liner. If the Engineer's selections differ from the Contractor's recommended material settings and if the Contractor objects to the Engineer's selections, the Contractor shall immediately present to the Owner, in writing, his objections and reasons and shall discontinue work on the well until a decision is reached in this regard. Otherwise, the Contractor shall construct the required well in the pilot hole, meeting all the provisions and guarantees of these specifications and other contract documents.
- B. Depth: The estimated depth of well, casing, cementing and underreaming are set forth in the proposal form and Item 4.0 of this specification and shall be used as a basis for bidding.
- C. Reaming: The pilot hole shall be stage pilot reamed to a minimum diameter of 4 inches greater than the outside diameter of the surface casing.
- D. Multi-Shot Alignment Survey: After reaming and before the surface casing is installed, the alignment of the hole shall be checked by Baker Hughes INTEQ or GyroData continuous alignment survey or approved equal, with readings at intervals no larger than 15 feet from the land surface to the depth selected for the bottom of the surface casing. The surveying instrument shall be held in the center of the hole with a guide or guides. The outside diameter of the guide shall be no more than 2 inches smaller than the hole diameter, and the length of the guide shall be at least 15 feet. The alignment survey shall be interpreted and plotted at the well site by the well surveying company before the surface casing is placed in the hole. Two copies of the

data and interpretative graphs shall be furnished to the Engineer. For any 300 foot or shorter section of the hole surveyed, the center line of the hole shall not vary or deviate more than 10 inches from a straight line connecting the two center points of the hole at the ends of the section, and a straight line connecting the two center points of the hole at the ends of any 100 foot section shall not vary or deviate from a vertical line through one of these points by more than 18 inches in the 100 foot section. If the alignment survey shows that a straight line connecting the two center points of the hole at the ends of any 100 foot section varies or deviates from a vertical line through one of these points by more than 18 inches in the 100 foot section, or if the alignment survey shows that the center line of the hole varies or deviates more than 10 inches from a straight line connecting the two center points of the hole at the ends of any 300 foot or shorter section, the Contractor shall correct the alignment survey or abandon and plug the hole and drill another hole at the site.

- E. Casing: The surface casing which shall be new steel A.P.I. line pipe, Grade B or better, with plain ends beveled for welding and meeting AWWA standards. The surface casing may not contain more than 8% lead. The lower end of the surface casing shall be fitted with a standard combination float and guide shoe into the developed formation.

The surface casing shall be equipped with centering guides, the first one located about 4 feet above the bottom of the casing and then one approximately every 80 feet above that to the surface to hold the casing in the center of the hole. The top of the casing shall extend three (3) feet above the land surface.

- F. Welding: Welding of the surface casing shall be done in accordance with the American Welding Society Specifications and the American Petroleum Institute Specifications.

- G. Grouting: The surface casing shall be grouted in place with a minimum of 2 inches of cement grout around the outside of the casing from the bottom to the top using standard Halliburton method.

The cement used shall be Portland with eight percent or less additive. The cement and gel shall be mixed with water to a slurry weight of 13.1 pounds or more per gallon. The slurry shall be weighted with a standard mud balance and the slurry weight shall be maintained as specified during the cementing operations. A reserve of at least 50 percent over the calculated volume of cement required for the cementing shall be stocked on location as a safety factor to fill washouts in the hole. The cement, after placement shall be allowed to set for a period of not less than 36 hours, after which the plug at the bottom of the casing may be drilled. The drilling fluid shall then be treated to eliminate all cement contamination prior to beginning any other drilling operation.

- H. Underreamed Hole Below the Surface Casing: The hole below the 24 inch surface casing shall be underreamed to a diameter of 28 inches to a depth of at least 10 feet below the lowest water-bearing formation to be screened in the well. The Engineer shall determine modifications to the size of the underreams. The last 5 feet of hole

shall extend into the impervious stratum below the underreamed hole and shall be 3 inches larger than the outside diameter of the production casing, and shall act as a means of centering the lower end of the pipe string.

The underreaming shall be done with a Servco cone type hydraulic underreamer or approved equal. A Halliburton X-Y Caliper log, or approved equal, shall be made of the underreamed hole. If the X-Y Caliper log shows that the diameter of the underreamed hole is less than specified at any place, the contractor shall scrape the underreamed section through its entire length with a Servco cone type hydraulic underreamer or approved equal and a new X-Y Caliper log run. This procedure will be repeated until a X-Y Caliper log is run showing an underreamed section of full diameter. The additional cost of underreaming and logging will be the responsibility of the contractor at no expense to the owner.

- I. Desander: A desander shall be provided to remove sand from the drilling fluid during the underreaming of the hole below the casing.

7.01 SCREEN AND BLANK LINER: The lengths of the liner and the positions at which the liner shall be set in the well have been estimated as shown by the base lengths given in the Section 4.01. The exact material settings will be selected after the pilot hole has been completed. The type and a description of the screen which the Contractor proposed to use shall be submitted to the Engineer for approval before it is ordered by the Contractor. The size of the screen opening to be used on the screen shall be selected by the Contractor based on the character and sieve analysis of the formation samples and type and grading of the gravel selected.

- A. Well Screen: The screen in the liner shall be new continuous slot, wire wound, stainless steel screen as manufactured by Weatherford/Johnson Screens or Alloy Machine Works. The pipe used in the screen shall be fabricated entirely of 304 stainless steel, and equal in size and weight to that of the blank liner with plain ends beveled for welding. The pipe used in the screen shall be perforated with ½" diameter round holes and provide a minimum of 17% open screen area.
- B. Bottom Liner: The bottom end of the liner shall consist of 12 foot to 15 foot of new A. P. I. line pipe, Grade B or better, fitted with back pressure valve, wooden wash plug, and set nipple.

Make-up liner and screen so that screen sections are set opposite to selected water-bearing sands as approved. The screen and liner shall be equipped with a suitable number of centering guides to maintain its position concentric with underreamed hole and surface casing spaced not more than 50 feet apart.

- C. Guides: Two groups of three centering fins shall be placed on the outside of the blank liner in the lap between the liner and the surface casing. The first group of centering fins shall be about five feet above the bottom of the surface casing and the other about fifteen feet below the top of the blank liner. Centralizers shall be used also at approximately 80 foot intervals between the liner and the underreamed hole.

8.01 MATERIAL CERTIFICATION:

All casing and liner shall weigh the amount per foot as specified above. A certificate from a reliable testing laboratory indicating that the casing and liner provided meets the specifications shall be furnished to the Engineer. The testing laboratory will provide a means of tracing the material to assure the certificate covers that material used in the field.

9.01 GRAVEL WALL:

- A. Graveling Operation: After the liner is in place, the annular space between the liner and the face of the underreamed hole and between the liner and the surface casing shall be filled with selected gravel to within ten feet (10') of the top of the liner. The gravel shall be placed in the well through a gravel line which shall first be set at the bottom of the well and gradually withdrawn as the gravel rises. The gravel shall be pumped from the surface through this line. A wash line shall be set inside the liner to the bottom of the liner and at the Contractor's option, the well shall be washed through the back pressure valve during the graveling operation. A quantity of gravel amounting to at least 20 percent more than the calculated volume of the annular space between the underreamed face of the well and the outside of the liner, plus the annular space between the liner and surface casing, shall be stocked on location before the graveling operation is started. After development, testing, and completion of the well, the gravel level shall be checked and returned to ten feet (10') below the top of the liner.
- B. Gravel Type: The type and size of the gravel to be used shall be determined and selected by the Contractor from the character and sieve analysis of the water-bearing formation. The gravel selected by the Contractor shall be one of a mixture of Texas Construction materials company's or its successor's well gravel types or approved equal. The gravel shall be washed, screened, and without sharp edges. The gravel shall be free of all dirt, trash, clay, or other foreign substances. Crushed gravel shall not be used. A sample of the gravel and the sieve analysis of the gravel shall be delivered to the Engineer at the time the Contractor submits his evaluation of the pilot hole. The Engineer's approval of the gravel shall in no way, however, relieve the Contractor of meeting all the well performance guarantees required by these specifications and other contract documents.
- C. Disinfection of Gravel: Immediately after the liner is set in place and before the gravel is placed in the well, the drilling fluid shall be circulated in the hole. Graveling shall be commenced with injection of 50 mg/L of chlorine solution so as not to cause flocculation of the drilling mud during the entire graveling operation. Do not use calcium hypochlorite or sodium hypochlorite in sufficient amounts as to cause excessive flocculation of the mud.

10.01 WELL DEVELOPMENT:

- A. Methods and Purposes: Immediately after the gravelling operation is completed, the well shall be thoroughly developed by mechanical and chemical methods. Developing shall consist of the simultaneous use of mud removing chemicals with agitation and washing with a tandem agitator under pressure, backwashing and pumping. The pumping shall remove the mud cake from the face of the water-bearing formation and any mud material that has penetrated the gravel pack and the water-bearing formation. The water-bearing materials and gravel pack, shall be stabilized to obtain optimum production from the well.

The methods and procedures used for development shall be at the option of the Contractor, but subject to approval by the Engineer.

The Engineer's approval of the methods and procedures used by the Contractor shall in no way, however, relieve the Contractor of meeting all the well performance guarantees required by these specifications and other contract documents.

- B. Development Time: Development of the well shall not be stopped, without approval of the Engineer, before at least ten (10) eight-hour tours have been spent on development.

A record of development time shall be maintained during the development phase. Except for the time required for the first installation of the test pump and motor, the time required for installation and operation of development tools and equipment and development test shall be recorded as development time. Time spent on the first installation of the test pump and motor and on rig, tool, or equipment, shall not be logged as development time.

- C. Disinfection: The well shall be disinfected in accordance with current AWWA standards for well disinfection. After the well is agitated and before the test pump is installed the well shall be disinfected with at least 50 pounds of approximately 70 percent granulated calcium hypochlorite for at least six hours. The calcium hypochlorite shall be placed in the screened section of the well through an agitator. After the test pump is installed, at least 50 pounds of approximately 70 percent granulated calcium hypochlorite shall be poured in the well and the well agitated by turning the pump on and off without discharging water at the surface.

- D. Development Tests: Water production tests and measurements of the static and pumping water levels shall be made at intervals during the development to evaluate the progress made by the development operations. The production tests shall be made with test pump equipment and at various rates of production. A pumping test shall be run during part of the latter portion of the development to determine whether the suspended solids guarantees appear to have been met. Tests performed during development shall not be counted as part of the pumping tests. The Contractor shall not call for the pumping tests to be performed until he has data from development to indicate that the guarantees can be met in the final test. The Contractor shall give the Engineer twenty-four hours (24) notice before the start of the pumping tests in Section 11.

- E. Cleaning Bottom of Well: After developing with the agitator is completed, the well shall be sounded, and if any material is found inside the well above the bottom of the lowest screen, it shall be cleaned out of the well before the well is tested.

11.01 PUMPING TESTS:

- A. Test Pump Equipment: The CONTRACTOR shall furnish and install and operate a test pump complete with engine and pipe orifices for measuring pumping rates from fifty (50%) percent of the specified rate to two hundred (200%) percent of the specified rate. Flow rate measurements shall be made with a pipe orifice of the proper/adequate size complete with a piezometer tube. Water level measurements shall be made with an electric measuring line to the nearest one-tenth (0.10') foot. A valve shall be provided on the pump discharge near the pump to assist in regulating the rate of discharge.

Development test pumping operations to dislodge/remove formation fines, remove drilling fluid and develop the well, includes a minimum sixty (60) hours of intermittent surging and pumping at various flow rates. Measurements of the production rate and water levels shall be taken and recorded during the pumping cycles to determine potential gain in specific capacity of the well from the development procedures utilized.

- B. Step Tests: Following the minimum development test pumping hours, a series of four (4) production step tests and one (1) thirty-six (36) hour continuous test shall be run as follows:

TEST PUMPING SCHEDULE

Pumping	60% design rate	3 hours
Recovery		3 hours
Pumping	80% design rate	3 hours
Recovery		3 hours
Pumping	100% design rate	3 hours
Recovery		3 hours
Pumping	120% design rate	3 hours
Recovery		24 hours minimum
Pumping	design rate	36 hours
Recovery		24 hours

Water level measurements shall be taken at 15 minute intervals during pumping and recovery periods. During the 24 hour minimum recovery before the continuous test, no water level measurements will be required except for the 3 hours immediately succeeding the last step test, and the 1 hour immediately preceding the 36 hour continuous pumping test.

If the specified capacities obtained by the production step tests indicate a general increase in specific capacity as the flow rate increases, the well shall be considered not fully developed and additional development and testing shall be required at the CONTRACTOR's expense.

During the pumping tests, the suspended solids content of the water from the well shall be measured by the CONTRACTOR with an 8-liter Imhoff cone, catching the water at the lower edge of the discharge orifice. The water produced from the well shall, on a consistent basis, not contain more than 0.2 milliliter of suspended solids per 8 liters of water at any time after ½ hour, and 0.1 milliliter of suspended solids per 8 liters of water at any time of the three hours of continuous pumping at the design rate or lesser pumping rates.

C. Water Rights: The Owner shall assume all responsibility for reduction in yield of wells or water supply owned by others or for any infringement on water rights of others due to operation of wells installed or operated under this contract. The Owner agrees to indemnify the Contractor for any cost connected with any infringement or claim of infringement upon such water rights of others.

D. Well Cleaning: After testing of the well is completed, the well shall be sounded and if there is any sand or other material inside the well above the bottom of the lowest screen, this material shall be cleaned out of the well. If the amount of such sand or other material found above the bottom of the lowest screen is excessive in the opinion of the Engineer, the Engineer may require the Contractor to retest the well at the Contractor's expense after the sand or other material is cleaned out of the well.

The well shall be cleaned of foreign substances, including, but not limited to, oil, grease, and scum on the water's surface.

E. Well Records: Upon completion of the well, the Contractor shall furnish in triplicate a complete written log of the well showing the formations encountered the types and locations of all material settings, a State of Texas Well Report, sieve analysis, cementing report, and all other pertinent information of the well.

F. Completed Well: The completed well shall be left by the Contractor in good condition, meeting all the requirements of these specifications as to the diameter, material settings, alignment, and the like. The Owner will not be required to accept the well or pay the Contractor for it if any of the well's component parts are left in a damaged condition.

12.01 WELL PRODUCTION AND OTHER GUARANTEES:

A. Production: Well and pump installation for final testing shall be guaranteed to produce 1,500 gallons per minute of capacity during this 24-hour pumping test and perform at least 10 gallons per minute per foot of drawdown (10 GPM/ft. specific

capacity) after one hour of continuous pumping at this rate. This is the one hour specific capacity.

If the well does not produce the specified capacity specified, the following procedure will be used:

1. The well driller will at his expense hire a hydrologist approved by the ENGINEER who will determine the efficiency of the well by a method acceptable to the ENGINEER.
2. If the hydrologist and ENGINEER determine that the well is seventy-five (75%) percent efficient or better, the well will be accepted.
3. If the efficiency of the well is less than seventy-five (75%) percent and the hydrologist and the ENGINEER determine that a better efficiency can be obtained, the well driller will resume well development at no cost to the OWNER. Development will continue until seventy-five (75%) percent efficiency is obtained or the hydrologist and ENGINEER determine that further development will not increase the efficiency of the well.

- B. Sand Content: Water from well shall be substantially free of sand. It is understood that some sand may be produced and the allowable sand content of water will be based on the Engineer's judgment. Under no circumstances shall the average sand content of water from well exceed ½ ounce of dry sand per 100 gallon of water sampled at the end of one hour pumping at the guaranteed rate. The Owner reserves the right to refuse or to accept the well if water produced contains more than the maximum amount of sand specified.
- C. Defective Work or Material: If the work or any part thereof, or any material brought on the site for use in work or selected for same shall be considered by the Engineer as unsuitable or not in conformity with specifications, the Contractor shall, after receipt of written notice from the Engineer, forthwith remove such material and rebuild or otherwise remedy such work so that it shall be in full accordance with contract documents.
- D. Period of Guarantee: The Contractor further agrees that all work will be free of defects in workmanship and materials for a period of one year from the date of final acceptance by the Owner.
- E. Conditions of Guarantee: It is a condition of the guarantees made hereunder that the Owner agrees to operate the well (and pump if furnished under this contract) hereunder in accordance with standard operating practice.

13.01 WELL WATER ANALYSIS AND TESTS:

- A. Chemical Analyses of Water: Four, one-gallon water samples shall be collected just prior to the end of the pumping period. The CONTRACTOR shall have a complete

standard water analysis made of one sample of the water by a laboratory acceptable to the ENGINEER. The analysis shall include accurate determination of all primary, secondary, and radiological constituents normally included in an analysis of municipal water by the Texas Commission on Environmental Quality (TCEQ). The results of the analysis shall be furnished to the ENGINEER.

- B. Disinfection: The well shall be disinfected in accordance with current AWWA standards for well disinfection. After the well has been developed and cleaned of sand, disinfect with a solution showing a chlorine residual of 50 parts per million. Chlorinated lime solution poured into well must be agitated and mixed thoroughly with the water in the well. In addition, flush all of the material above the water level in the well and wash it down with disinfecting solution. Mixing of solution may be aided by using a hose of pipe or by using dry ice. After agitated, the chemical should be left for at least 6 hours then the well shall be free from the odor of chlorine.

- C. Bacteriological Analysis:

After all new pumps, equipment, etc. are installed in the well, a sample of water shall be collected in a sterile container on three successive days and a water bacteriology test shall be made by a laboratory approved by the TCEQ. The ENGINEER shall be furnished a copy of the laboratory reports. If any coliform organisms are found present in any sample, the CONTRACTOR shall re-sterilize the well, and have the water resampled as stated above until such time as no coliform organisms are found present in three successive water samples collected, or until such time as the ENGINEER becomes convinced that coliform organisms exist naturally in the water-bearing formation and are not present in water produced from the well as a result of the operations of the CONTRACTOR.

14.01 DISPOSAL OF WASTE WATER:

The Contractor shall be responsible for disposing of the waste water during the drilling, developing, and testing of the water well, with the Engineer's approval.

15.01 SITE CONDITIONS:

The Contractor shall be responsible for clearing the site and preparing the drilling equipment as required. The Contractor shall also maintain access to the existing well and plant facilities at all times. The existing plant must also be secured with intruder resistant fencing during non-working periods. It is the Contractors responsibility to keep the site secure at all times.

16.01 CAMERA SURVEY:

After 48 hours from completion of the well and prior to setting the pump in place, the Contractor shall obtain a camera survey of the casing in place to serve as a permanent record of the casing condition upon well completion. The camera survey shall be run out continuously to the total depth of the well.

17.01 MINIMUM STANDARD:

As a minimum, the Contractor shall comply with the rules and regulations as stated in "Rules & Regulations for Public Water Systems" as published by the TCEQ as adopted in 1978 and the latest revisions and amendments thereto.

18.01 TEMPORARY CAP:

The Contractor shall place a temporary cap, made of suitable material, over the well hole after the well has been drilled and prior to setting the permanent pump. The cap shall be installed so that entry by others is prohibited.

19.01 EXPERIENCE:

The well driller shall have a minimum of ten (10) years experience in drilling water wells in the Harris County, Montgomery County, and Fort Bend County areas.

20.01 WORKMANSHIP:

The CONTRACTOR shall employ competent workmen for the execution of the work, and all work shall be performed under the direct supervision of an experienced well driller. The well driller shall be licensed by the State of Texas and as evidence of his qualifications the license number of each driller shall be on display during all rig operations.

21.01 GUARANTEE:

The guarantee provisions of this specification require prompt replacement of all defective workmanship and materials occurring within one year of job acceptance. This includes all work required to remove and replace defective items and to make all necessary adjustments to restore the entire installation to its original specified condition at the time of acceptance.

22.01 MAINTENANCE MANUALS:

The CONTRACTOR shall furnish four (4) complete maintenance manuals, make and model number, shop drawings and parts list for all functioning materials and/or equipment installed in the complete project. Such manuals, drawings and parts list shall be delivered directly to the ENGINEER upon completion of the project.

END OF SECTION

SPECIFICATION WP-206

DEEP WELL TURBINE PUMP

1.01 SCOPE:

The Contractor shall furnish and install an oil lubricated turbine pump, complete with piping and appurtenances as shown on the drawings, as specified herein, and as necessary for a complete and functioning well pump system. The well pump shall deliver 1,500 GPM at 729 feet Total Dynamic head with a pump efficiency of not less than 80%.

2.01 PUMP:

The pump shall be manufactured by American Turbine Pump, Peabody-Floway, Layne-Bowler, Goulds, Peerless, Byron Jacksons, or approved equal.

- A. Pump Bowls: The pump bowls shall be equipped with wear rings for maintenance and replacement. The top of pump bowls shall have a minimum of 100 foot submergence below the pumping level. The quantity of pump bowls shall be determined from the submitted pump curve and the test hole data.
- B. Line Shaft: The line shaft shall be machined, ground and polished precision shafting of ample size to operate pump without distortion or vibration. The line shaft shall be furnished in interchangeable sections not over 20 feet in length and shall be coupled with high grade, machined steel couplings.
- C. Shaft Enclosing Tube: The shaft enclosing tube shall consist of interchangeable sections not over 5 feet in length of min. 2-1/2" Schedule 80 steel pipe to receive bronze couplings which will act as line shaft bearings.
- D. Pump Column: The pump column shall be ANSI threaded and coupled steel pipe. The column shall include rubber centering spiders on 20 foot centers.
- E. Suction Pipe: A 10 foot section of required diameter suction pipe shall be connected to the bottom of the bowl assembly.
- F. Cone Strainer: The cone strainer shall have a net inlet opening area greater than 4 times the area of the suction pipe.
- G. Discharge Head: The discharge head shall be determined according to pump curve and test hole data with fabricated steel, separate base plate, and ANSI Class 125 flanged outlet above ground. The discharge head shall include a 5 quart 120 v ac automatic solenoid oiler with provision for manual oiling. The discharge head shall be furnished by the pump manufacturer.

- H. Head Shaft: The head shaft shall be machined, ground and polished precision shafting of ample size to operate the pump without distortion or vibration. The headshaft shall extend from the coupling atop the stuffing box in the pump head, through the motor stand, through the motor to the head shaft nut (vertical adjusting nut).
- I. Water Level Gauge: The deep well shall be equipped with a 1/4 inch O.D., type 1005-4204, 0.035-inch wall thickness, PVC coated (0.032-inch wall) single line stainless steel tubing as manufactured by Dekoron or Parker ISST-4, gauge, and necessary fittings to extend from the surface to the bottom of suction pipe. The 4-1/2" diameter gauge shall be calibrated from 0 to 1000 feet of H₂O. A suitable connection and air pump shall be furnished for testing the well.

3.01 MOTOR:

The well pump shall be equipped with a minimum 350 horsepower, 1800 RPM induction motor, suitable for operation from an electrical power supply of 480 volts, 3 phase, 60 hertz, with a 1.0 service factor. The motor enclosure shall be type TEFC. The motor shall be manufactured to comply with NEMA Design B, and shall be furnished within the following specified criteria:

- A. Minimum design power factor of 85% (unimproved)
- B. Minimum efficiency of 93.5% (at full load)
- C. Minimum of Class "F" insulation
- D. Minimum total down thrust capacity of 32,000 pounds.

The motor shall exhibit normal starting torque, normal slip, and shall be suitable for reduced voltage, auto-transformer starting.

The motor shall be provided with oil lubricated thrust bearings having a rated capacity of not less than 32,000 pounds (down thrust) and a bearing life of not less than 70,000 hours. The thrust bearings shall be mounted in the upper housing. Provide a lube oil reservoir of adequate size to maintain the bearings fully submerged during periods of non-operation. The reservoir shall be provided with convenient openings for draining and filling and an oil level sight gage etched to indicate proper lubrication levels (static, normal, low).

The motor shall be provided with space heaters to prevent condensation from accumulating while the motor is not running.

The motor shall be provided with resistance temperature detectors (RTD); a minimum of six (6) located in the stator windings and one (1) at each bearing. The RTD's shall be 100 OHM Platinum (DIN 43760) resistance at zero (0) degrees centigrade. The

RTD's shall be interfaced with the "Motor Protection Relay" covered in the Electrical Specifications.

The motor shall be provided with an "Anti-Back-Spin" Ratchet mechanism. The rotation in the reverse direction shall not exceed ten (10) degrees.

In addition to the anti-back-spin ratchet described above, the Contractor shall mount a speed detection switch, with a normally closed contact, a zero speed or motion, with contact opening if reverse rotation on shaft occurs. The sensor will interface with motor protection relay to prevent starting if rotation is detected. Vendor shall be Culter Hammer Type E57 or an approved equal.

The Contractor shall furnish the following documentation with "Approval Drawing" submittal.

- A. Motor Outline with dimensional data, weight, and noise data.
- B. Certified Test Data for typical motors of horsepower rating and voltage.
- C. Guaranteed Efficiency Curves indicating motor efficiency versus load.
- D. Guaranteed Power Factor Curves indicating motor power factor (uncorrected) versus load.
- E. Letter of Warranty, with a minimum period of two (2) years, covering defects in workmanship and materials.

Submit a written certification of minimum guaranteed efficiency, inclusive of stray load losses, thrust and guide bearing losses, as outlined in Test Method "B" of IEEE Standard #112. This certified report shall be signed by the testing facility director, and shall be submitted on IEEE Format (Typical Report of Test Form for Induction Motors).

Applicable Standards: NEMA MG-1
NEMA MG-13
IEEE #112
IEEE #85

The motor shall be as manufactured by Westinghouse, Continental, Louis Allis, Toshiba, U.S. Motor Division of Emerson Electric, or an approved equal.

4.01 FIELD TEST OF PERMANENT PUMP:

During the well production test, additional test readings and calculations shall be done by the Contractor to demonstrate the performance of the pump and motor under actual field conditions. All testing shall be in accordance with "Field Testing of Deep

Well Vertical Turbine Pumps” found as an appendix attached to AWWA Standard E-101-88. All information shown of the field test report shall be submitted in duplicate to the Engineer. The Contractor will be required to provide all test equipment and personnel. Seventy-two (72) hours notice shall be given to the Engineer in order that a representative may be present to witness the tests.

5.01 CORROSION CONTROL EQUIPMENT FOR EXTENDED SERVICE LIFE:

The Contractor shall furnish electrical isolation for the well pump, motor, discharge piping and lubricator for the prevention of Electrolytic Corrosion. The Contractor shall furnish and install sacrificial zinc anodes on the lower 40 foot of pump discharge column for galvanic corrosion control. The anodes shall be welded to the column pipe.

6.01 SUBMITTALS:

The Contractor shall submit six (6) sets of pump information for approval by the Engineer. The pump design will be based on the completed well investigation. The information shall include shop drawings, specifications, pump and motor test data, installation instructions, and operation and maintenance manuals.

END OF SECTION

SPECIFICATION 210
WELDED STEEL GROUND STORAGE TANK

- 1.0 **SCOPE OF WORK:** The Contractor shall furnish and install one (1) welded steel ground storage tank complete with all related equipment, of the size and capacity as shown on the plans and as specified herein.
- 2.0 **STANDARD SPECIFICATION:** The welded steel ground storage tank shall conform to the most recent revision of ANSI/AWWA specifications D100.
- 3.0 **DIAMETER AND HEIGHT:** The maximum inside diameter of the tank shall be 55 feet. The height of the tank wall shall be 32 feet to give minimum working volume below the overflow weir of 500,000 gallons.
- 4.0 **TYPE OF CONSTRUCTION:** The structure shall consist of a steel ground storage tank set on a sand-filled concrete ring wall as shown on the plans and specified herein.
- 5.0 **STRENGTH AND STABILITY:** The thickness of the plates and type of joints shall be sized to transmit the stresses safely when the tank is full. Wind stresses shall be included in the design (based on 100 M.P.H. wind speed from any direction). Complete detailed drawings clearly showing the dimensions of all parts, methods of construction, connections, openings, and design calculations, etc., shall be submitted to the Engineer for approval.
- 6.0 **FOUNDATION:** The foundation shall consist of a sand filled reinforced concrete ring wall as shown on the drawings. Unless otherwise noted, the entire foundation area shall be scarified to a depth of six (6) inches and the subgrade compacted to 95% standard Proctor Density.

The sand fill shall be placed in six (6) inch loose lifts and compacted to 95% Standard Proctor Density at optimum moisture after the concrete ring has been constructed. The sand shall be free of clay lumps and any deleterious materials. The grain size of sands used for backfill shall be such that not more than 10% is retained on a 200 mesh sieve. The concrete ring shall be constructed of Class A reinforced concrete to the dimensions shown on the plans.

- 7.0 **PIPE CONNECTIONS AND APPURTENANCES:** The tank shall include all pipe connections and appurtenances as shown on the drawings as follows:
 - a) One (1) 20 inch double goose neck roof vent with No. 16 mesh A-316 stainless steel screen over vent openings.
 - b) One (1) 12 inch inlet connection.

- c) One (1) 12 inch overflow and drain with a hinged and weighted cover that has no gaps over 1/16 inch. Pipe shall not be subject to submergence
- d) Two (2) 18 inch pump suction pipes.
- e) One (1) 4' x 4' shell manway as per API Std. 650 with Davit.
- f) One (1) 30 inch Dia. Flanged manway.
- g) Two (2) 30" x 30" Roof Hatches with lockable hasp and handle.
- h) One (1) Exterior Ladder with safety cage enclosure meeting OSHA standards.
- i) One (1) Interior Ladder meeting OSHA standards.
- j) Handrails along the extremity of the tank a distance of 10 foot measured from each side of the Exterior Ladder.
- k) One (1) 4-1/2" Dia. Level indicator gauge graduated in feet and tenths of a foot.
- l) One (1) 1 inch sampling tap assembly with hose bib.
- m) One (1) 1 inch outlet with coupling.
- n) Welded Steel roof sloped to prevent water ponding at a slope less than 0.75 inch per foot.

8.0 FINISHING AND PAINTING: Remove all weld sag, weld splatter, mill scale, oil, grease, dirt, etc. from the interior and exterior of tank surfaces. Grind all welds, edges and corners even. All ground storage tank coatings shall conform to NSF Standard 61 and meet requirements in Section WP-225 Painting.

9.0 TESTING: Following completion of erection, the tank shall be inspected and tested in accordance with the latest AWWA D100 specifications. The Contractor shall provide the x-rays, and the x-rays shall be come property of the Owner. After approved tank welds, the tank shall be tested for liquid tightness and settlement by filling the tank to its overflow elevation, as outlined in geotechnical report. Water required for testing will be furnished by the Owner without charge.

10.0 CLEANING AND DISINFECTION: The tank shall be cleaned and disinfected before being placed in service according to Section WP-275 of these specifications.

11.0 WARRANTY: The tank manufacturer shall warrant the tank against any defect in workmanship and materials for a period of one (1) year from the date of substantial completion. In the event any such defect should appear, it should be reported in writing to the Manufacturer during the warranty period.

- 12.0 DRAWINGS AND SUBMITTALS:** The contractor shall furnish the Engineer with five (5) copies of shop drawings for approval including all items necessary for a completed welded steel ground storage tank. The shop drawings shall be signed and sealed by a Professional Engineer registered in the State of Texas.

END OF SECTION

SPECIFICATION WP-212
GLASS COATED, BOLTED STEEL GROUND STORAGE TANK

1 GENERAL

1.1 Scope of Work

1.1.1 Furnish and erect a glass-fused-to-steel bolted water storage tank, including foundation, tank structure and tank appurtenances as shown on the drawings and described herein.

1.1.2 All required labor, materials and equipment shall be included.

1.2 References

1.2.1 SSPC SP-10 - Surface Preparation Standard – Near-White Metal Blast Cleaning.

1.2.2 ASTM C633-79 - Standard Test Method for Adhesion or Cohesive Strength of Flame-Sprayed Coatings

1.2.3 PEI Test T-21 - Test for Acid Resistance of Porcelain Enamels (Citric Acid Spot Test)

1.2.4 ASTM D51 62-91 - Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

1.2.5 ASTM B91 6-01 - Standard Test Method for Adherence of Porcelain Enamel Coatings to Sheet Metal

1.3 Qualifications of Tank Supplier

1.3.1 The Engineer's selection of factory applied glass-fused-to-steel bolted tank construction for this facility has been predicated upon specific criteria, methods, and an optimum coating for resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details, will not be permitted.

1.3.2 The bidder shall offer a new tank structure as supplied from a manufacturer specializing in the design, fabrication and erection of factory applied glass-fused-to-steel bolted tanks. The tank shall be manufactured in the United States.

1.3.3 Strict adherence to the standards of design, fabrication, erection, product quality, and long term performance established in this Specification will be required by the Owner and Engineer.

1.4 Submittal Drawings

- 1.4.1 Construction shall be governed by the Owner's drawings and specifications showing general dimensions and construction details, after written approval by the Engineer of detailed erection drawings prepared by the Contractor. There shall be no deviation from the Owner's drawings and specifications, except upon written order from the Engineer.
- 1.4.2 The bidder is required to furnish, for the approval of the Engineer five sets of complete specifications and construction drawings for all work associated with the tank. A complete set of structural calculations shall be provided for the tank structure and foundation. All such submissions shall be stamped by a Licensed Professional Engineer licensed in the state of project location, as well as, by a Licensed Professional Engineer employed on the tank manufacturer's engineering staff. Where the tank manufacturer's P.E. is licensed in the state of the project location, only one stamp is required. Submittals shall conform to Section 01330 – Submittal Procedures.
- 1.4.4 The tank manufacturer's standard published warranty shall be included with submittal information.
- 1.4.5 The dealer shall include the tank manufacturer's standard Operation and Maintenance Manual upon receipt of approved drawings.

2 DESIGN CRITERIA

2.1 Tank Size

- 2.1.1 The factory coated glass-fused-to-steel bolted tank shall have a nominal diameter of 55 feet, with a nominal sidewall height (to roof eave) of 32 feet.

2.2 Tank Capacity

- 2.2.1 Tank capacity shall be a minimum of 500,000 gallons (nominal, U.S.gallons) at 31 feet liquid depth.

2.3 Floor Elevation

- 2.3.1 Finished floor elevation shall be set as shown on drawings.

2.4 Tank Design Standards

- 2.4.1 The materials, design, fabrication and erection of the bolted steel tank shall conform to the AWWA Standard for "Factory-Coated Bolted Steel Tanks For Water Storage" - ANSI/AWWA D103, latest revision.

- 2.4.2 The tank coating system shall conform solely to Section 10.4 of ANSI/AWWA D103 latest revision.
- 2.4.3 All materials furnished by the tank manufacturer, which are in contact with the stored water shall be certified and listed by the National Sanitation Foundation (NSF) to meet ANSI/NSF Additives Standard No. 61. Certification of a coating type alone will not be sufficient to meet this requirement.

2.5 Design Loads (Complete the blanks)

- 2.5.1 Specific Gravity 1.0.
- 2.5.2 Design Freeboard 12 inches minimum.
- 2.5.3 Wind Velocity 100 mph.
- 2.5.4 Allowable Soil Bearing Capacity _____ psf (Per Eng.'s Soils Report)
- 2.5.5 Roof Snow Load 0 psf

3 MATERIALS SPECIFICATIONS

3.1 Plates and Sheets

- 3.1.1 All steel shall be smelted and produced in the United States of America.
- 3.1.2 Plates and sheets used in the construction of the tank shell, tank floor (when supplied) and tank roof, shall comply with the minimum standards of AWWA D103, latest edition.
- 3.1.3 Design requirements for mild strength steel shall be ASTM A1011 Grade 30 with a maximum allowable tensile stress of 14,566 psi.
- 3.1.4 Design requirements for high strength steel shall be ASTM A1011 Grade 50 with a maximum allowable tensile stress of 26,000 psi.
- 3.1.5 The annealing effect created from the glass coated firing process shall be considered in determining ultimate steel strength. In no event shall a yield strength greater than 50,000 psi be utilized for calculations detailed in AWWA D103, Sections 3.4 and 3.5.
- 3.1.6 When multiple vertical bolt line sheets and plates of ASTM A101 1 Grade 50 are used, the effective net section area shall not be taken as greater than 85% of the gross area.

3.2 Rolled Structural Shapes

3.2.1 Material shall conform to minimum standards of ASTM A36 or ASTM A992.

3.3 Horizontal Wind Stiffeners

3.3.1 Design requirements for intermediate horizontal wind stiffeners shall be of the "web truss" type with an extended tail creating multiple layers of stiffener, permitting wind loads to be distributed around the tank.

3.3.2 Web truss stiffeners shall be of steel with hot dipped galvanized coating.

3.3.3 Rolled steel angle stiffeners are not permitted for use as intermediate horizontal wind stiffeners.

3.4 Bolt Fasteners

3.4.1 Bolts used in tank lap joints shall be 1/2" - 13 UNC- 2A rolled thread, and shall meet the minimum requirements of AWWA D103, Section 2.2.

3.4.2 Bolt Material

3.4.2.1 SAE J429 Grade 2 (1" bolt length)

3.4.2.1.1 Tensile Strength - 74,000 psi Min.

3.4.2.1.2 Proof Load - 55,000 psi Min.

3.4.2.1.3 Allowable shear stress with threads excluded from the shear plane - 18,163 psi Min.

3.4.2.2 SAE J429 Grade 5 (1 1/4" bolt length)

3.4.2.2.1 Tensile Strength - 120,000 psi Min.

3.4.2.2.2 Proof Load - 85,000 psi Min.

3.4.2.2.3 Allowable shear stress with threads excluded from the shear plane - 29,454 psi Min.

3.4.2.3 SAE J429 Grade 8 (>1 1/4" bolt length)

3.4.2.3.1 Tensile Strength - 150,000 psi Min.

3.4.2.3.2 Proof Load - 120,000 psi Min.

3.4.2.3.3 Allowable shear stress with threads excluded from the shear plane - 36,818 psi Min.

3.4.3 Bolt Finish - Zinc, mechanically deposited.

3.4.3.1 2.0 mils (0.002 inches) Min. - under bolt head, on shank and threads.

3.4.4 Bolt Head Encapsulation

3.4.4.1 High impact polypropylene copolymer encapsulation of entire bolt head up to the splines on the shank.

3.4.4.2 Resin shall be stabilized with an ultraviolet light resistant material such that the color shall appear black.

3.4.4.3 The bolt head encapsulation shall be certified to meet the ANSI/NSF Standard 61 for indirect additives.

3.4.5 All bolts on the vertical tank wall shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.

3.4.6 All lap joint bolts shall be properly selected such that threaded portions of the bolts will not be exposed to the "shear plane" between tank sheets.

3.4.7 Bolt lengths shall be sized to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

3.4.8 All lap joint bolts shall include a minimum of 4 splines on the underside of the bolt head at the shank in order to resist rotation during torquing.

3.5 Sealants

3.5.1 The lap joint sealant shall be a one component, moisture cured, polyurethane compound. The sealant shall be suitable for contact with potable water and shall be certified to meet ANSI/NSF Additives Standard 61 for indirect additives.

3.5.2 The sealant shall be used to seal lap joints and bolt connections and edge fillets for sheet notches and starter sheets. The sealant shall cure to a rubber-like consistency, have excellent adhesion to the glass coating, low shrinkage, and be suitable for interior and exterior use.

3.5.3 Sealant curing rate at 73°F and 50% RH.

3.5.3.1 Tack-free time: 6 to 8 hours.

3.5.3.2 Final cure time: 10 to 12 days.

3.5.4 Neoprene gaskets and tape type sealer shall not be used.

4 GLASS COATING SPECIFICATION

4.1 Surface Preparation

- 4.1.1 Following the decoiling and shearing process, sheets shall be steel grit-blasted on both sides to the equivalent of SSPC SP-10 (Near-White Metal Blast Cleaning). Sand blasting and chemical pickling of steel sheets is not acceptable.
- 4.1.2 The surface anchor pattern shall be not less than 1.0 mil (0.001 inches).
- 4.1.3 These sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.

4.2 Sheet Edges

- 4.2.1 After initial sheet preparation, all full height vertical wall sheets and all rectangular shaped floor sheets shall be beveled. A metal coating of 316 stainless steel shall then be applied to these edges by an ARC thermal spray of 1.5 to 5 mils (0.0015 to 0.005 inches). The coating shall have a tensile strength of >1500 psi (per ASTM C633-79).

4.3 Cleaning

- 4.3.1 After fabrication and prior to application of the coating system, all sheets shall be thoroughly cleaned by a caustic wash and hot rinse process followed immediately by hot air drying.
- 4.3.2 Inspection of the sheets shall be made for traces of foreign matter, soil particles, grease or rust.

4.4 Coating

- 4.4.1 All side wall sheets shall receive one coat of a catalytic nickel oxide glass pre-coat to both sides and then air dried.
- 4.4.2 Another coat of milled cobalt blue glass shall be applied to both sides of the sheets and then dried.
- 4.4.3 A third coat of milled titanium dioxide reinforced white glass shall be applied to all interior sheet surfaces.
- 4.4.4 The same glass coating as applied to the exterior sheet surfaces shall be applied to the exposed edges.
- 4.4.5 The sheets shall then be fired at a minimum temperature of 1500° F in strict accordance with the manufacturer's ISO 9001 quality control procedures,

including firing time, furnace humidity, temperature control, etc.

- 4.4.6 The coating process is a 3 coat process. The interior color shall be white. The exterior color shall be cobalt blue.
- 4.4.7 The dry film interior coating thickness shall be 10.0 to 16.0 mils (0.010 to 0.016 inches) minimum.
- 4.4.8 The dry film exterior coating thickness shall be 6.0 to 11.0 mils (0.006 to 0.011 inches) minimum.

4.5 Factory Inspection

- 4.5.1 The manufacturer's quality system shall be ISO 9001 certified.
- 4.5.2 Chemical Resistance of Glass Coating
 - 4.5.2.1 Every batch of component frits shall be individually tested in accordance with PEI Test T-21 (Citric Acid at Room Temperature).
- 4.5.3 Low Voltage Wet Sponge Holiday Test
 - 4.5.3.1 The inside sheet surface shall be inspected using a low voltage wet sponge holiday tester in accordance with ASTM D51 62-91 Method A (Low Voltage Wet Sponge Testing).
 - 4.5.3.2 The tester shall be used at a voltage of 67.5 volts ($\pm 10\%$) and set so the alarm is sounded if the electrical resistance of the glass coating falls below 125,000 Ω ($\pm 10\%$). The tester shall have a valid calibration record. The testing solution used to wet the sponge shall contain a low sudsing wetting agent added at a ratio of not more than 1/2 fluid oz. per gallon of water.
 - 4.5.3.3 Frequency of the test shall be every sheet. Any sheet registering a discontinuity shall be rejected
 - 4.5.3.4 All inside sheet surfaces shall be holiday free.
 - 4.5.3.5 A 1000 volt dry test shall not be acceptable as this is not recommended by ASTM for coating thicknesses less than 20.0 mils (0.020 inches).
- 4.5.4 Measurement of Glass Thickness
 - 4.5.4.1 Glass thickness shall be measured using an electronic dry film thickness gage (magnetic induction type). The thickness gage shall have a valid calibration record.

4.5.4.2 Frequency of the test shall be every tenth sheet. The thickness of the glass shall be between 10.0 and 16.0 mils (0.010 and 0.016 inches).

4.5.5 Measurement of Color

4.5.5.1 The exterior color of the sheets shall be measured using a colorimeter. The colorimeter shall have a valid calibration record.

4.5.5.2 Frequency of the test shall be every tenth sheet. The color must fall within the tolerance, else the panel shall be rejected.

4.5.6 Impact Adherence Test

4.5.6.1 The adherence of the glass coating to the steel shall be tested in accordance with ASTM B916-01. Any sheet that has poor adherence shall be rejected.

4.5.6.2 Frequency of this test shall be one sheet per gage lot run minimum.

4.5.7 Fishscale Test

4.5.7.1 The glass coating shall be tested for fishscale by placing the full size production sheets in an oven at 400° F for one hour. The sheets will then be examined for signs of fishscale. Any sheet exhibiting fishscale shall be rejected and all sheets from that gage lot will be similarly tested.

4.5.7.2 Frequency of this test shall be one sheet per gage lot run minimum.

5. ERECTION

5.1 Foundation

5.1.1 The tank foundation is a part of this contract and shall be installed by the Contractor according to the detail in the construction drawings.

5.2 Tank Floor

5.2.1 Glass Coated Bolted Steel

5.2.2 Bolted steel panels shall be either placed over a 3 inch compacted sand base contained by a steel or concrete ring wall, or a non-extruding and resilient bituminous type filler meeting the requirements of ASTM D1751 if set on a concrete slab.

- 5.2.3 A plastic encapsulated nut shall be used to cover the bolt threads exposed on the inside of the floor. The plastic encapsulation shall be NSF compliant.
- 5.2.4 Leveling of the starter ring shall be required and the maximum differential elevation within the ring shall not exceed 1/8 inch, nor exceed 1/16 inch within any 10 feet of length.

5.3 Sidewall Structure

- 5.3.1 Field erection of the glass-coated, bolted-steel tank shall be in strict accordance with the procedures outlined in the manufacturer's erection manual, and performed by an authorized dealer of the tank manufacturer, regularly engaged in erection of these tanks, using factory trained erectors.
- 5.3.2 Specialized erection jacks and building equipment developed and manufactured by the tank manufacturer shall be used to erect the tanks.
- 5.3.3 Particular care shall be taken in handling and bolting of the tank panels, structural members, and appurtenances to avoid abrasion of the coating system. Prior to a liquid test, all surface areas shall be visually inspected by the Engineer.
- 5.3.4 An electrical leak test shall be performed during erection using a wet sponge 9 volt leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with manufacturer's published touch up procedure.
- 5.3.5 No backfill shall be placed against the tank sidewall without prior written approval of the tank manufacturer. Any backfill allowed shall be placed according to the strict instructions of the tank manufacturer.

5.4 Roof

- 5.4.1 Tanks with diameters of 14 to 31 feet shall include a radially sectioned roof fabricated from glass - coated, bolted steel panels, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels utilizing the same sealant and bolting techniques, to assure a weather tight assembly. The roof shall be clear - span and self-supporting. Both live and dead loads shall be carried by the tank walls. The roof shall be of a rolled knuckle design, with no rolled angle connection between sidewall and roof panels.
- 5.4.2 Roofs for tanks greater than 31 feet in diameter shall be constructed of non-corrugated triangular aluminum panels which are sealed and firmly clamped in an interlocking manner to a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a dome structure.
 - 5.4.2.1 The dome shall be clear span and designed to be self-supporting from

the periphery structure with primary horizontal thrust contained by an integral tension ring.

5.4.2.2 The dome and tank shall be designed to act as an integral unit. The tank shall be designed to support an aluminum dome roof including all specified live loads.

5.4.2.3 Materials:

5.4.2.3.1 Triangulated dome frame struts: AA6005A-T6 aluminum.

5.4.2.3.2 Structural frame node plates: 0.375 inch nominal thickness, AA6061-T6 aluminum,

5.4.2.3.3 Triangular dome panels: 0.050 inch nominal thickness, AA3003-H16 aluminum Sheet.

5.4.2.3.4 Perimeter tension/compression ring: AA6005A-T6 aluminum.

5.4.2.3.5 Fasteners: AA2024-T4 aluminum or austenitic series 300 stainless steel.

5.4.2.3.6 Sealant: Silicone, conforming to Federal Specification TT-S-00230.

5.4.2.3.7 Gaskets: Silicone, conforming to Federal Specification ZZ-R-765, Class 2, Grade 50 or equal or Neoprene conforming to ASTM C509-00.

5.4.2.3.8 Dormers, doors, and hatches: AA6061 -T6, AA6005A- T6, AA5086-H34 or AA5052-H36 aluminum, 0.090" nominal thickness.

5.4.3 Roof Vent

5.4.3.1 A properly sized double goose neck vent assembly in accordance with AWWA D103 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum design rate of water fill or withdrawal, the resulting interior pressure or vacuum will not exceed 0.5 inch water column.

5.4.3.2 The overflow pipe shall not be considered to be a tank vent.

5.4.3.4 The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including a No. 16 mesh A-316

stainless steel screen.

- 5.4.4 The manufacturer shall furnish two roof openings which shall be provided with a hinged cover and a hasp for locking. The openings shall have a clear dimension of at least 30 inches in both directions. The openings shall have a curb at least 4 inches in height, and the cover shall have a downward overlap of at least 2 inches.

5.5 Appurtenances (per AWWA D103, Section 5)

5.5.1 Pipe Connections

- 5.5.1.1 Where pipe connections are shown to pass through tank panels, they shall be field located, saw cut, (acetylene torch cutting or welding is not permitted), and utilize an interior and exterior flange assembly. Tank shell reinforcing shall comply with AWWA D103 latest edition. A single component urethane sealer shall be applied on any cut panel edges or bolt connections.

5.5.1.2 Overflow piping shall be 12 inches diameter

5.5.1.3 Inlet piping shall be 12 inches diameter

5.5.1.4 Pump suction piping shall be 18 inches diameter

5.5.2 Tank Ladders

5.5.2.1 Exterior and interior tank ladders shall be furnished and installed as shown on the drawings.

5.5.2.2 Ladders shall be fabricated of aluminum and utilize grooved, skid-resistant rungs.

5.5.2.3 Safety cage and step-off platforms shall be fabricated of galvanized steel. Exterior ladders shall be equipped with a hinged lockable entry device meeting OSHA standards.

5.5.3 Access Doors

5.5.3.1 Two shell manways shall be provided as shown on the drawings in accordance with AWWA D103.

5.5.3.2 The manway openings shall be a minimum of 30 inches in diameter and a minimum of 4' by 4'. The access door (shell manway) and the tank shell reinforcing shall comply with AWWA D103 latest edition, Sec. 5.1.

- 5.5.4 Identification Plate: A manufacturer's nameplate shall list the tank serial number, tank diameter and height, and maximum design capacity. The nameplate shall be affixed to the tank exterior sidewall at a location approximately 5 feet from grade elevation in a position of unobstructed view.

6 FIELD TESTING

6.1 Hydrostatic

- 6.1.1 Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling tank to its overflow elevation.
- 6.1.2 Any leaks disclosed by this test shall be corrected by the authorized dealer in accordance with the manufacturer's recommendations.
- 6.1.3 Water required for testing shall be furnished by the Owner at the time of tank erection completion, and at no charge to the Contractor. Disposal of test water shall be the responsibility of the Owner.
- 6.1.4 Labor and equipment necessary for hydrostatic tank testing is to be included in the price of the tank.

7 DISINFECTION

7.1 Standards

- 7.1.1 The tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA Standard C652-02 "Disinfection of Water Storage Facilities."
- 7.1.2 Disinfection shall not take place until tank sealant is fully cured (see Sect. 3.5.3 above).

8 TANK MANUFACTURER'S WARRANTY

- 8.1 The tank manufacturer shall include a warranty for the tank materials and coating. This warranty shall provide assurance against defects in material or workmanship for the period of 1 year and corrosion of the glass coated surface for the period of 5 years.

SPECIFICATION WP-215

WELDED STEEL HYDROPNEUMATIC TANK

1.0 **SCOPE:** The Contractor shall furnish and install a welded steel pressure tank and related equipment as shown on the plans and as specified herein.

2.0 **DESIGN AND FABRICATION:**

- a) Size: 1-5,000 gallon, 6'-0" diameter
- b) Code Inspection and Stamp: ASME Section VIII Div. 1
- c) Design Pressure: 65 PSIG at 100 Degrees Fahrenheit
- d) Corrosion Allowance: 0.125"
- e) Safety Factor: 4:1

3.0 **TESTING:**

- a) Radiograph: Spot
- b) Air Test: Not Required.
- c) Stress Relief: Not Required.
- d) Test Pressure: 98 PSIG

4.0 **MATERIALS:**

- a) Shell shall be ATSM A516 Grade 70
- b) Heads shall be ATSM A516 Grade 70
- c) Supports shall be ASTM A36
- d) Nozzles and man way necks shall be seamless pipe ASTM A53 Grade A or B or rolled from ASTM A285 Grade C.
- e) Forged steel flanges shall conform to ASAB 16.5-1961
- f) Couplings shall be 3000# threaded A105 Grade II
- g) Bolting shall conform to ASTM A307 Grade B galv.
- h) Nuts shall be Am. Std. Heavy hex
- I) Gaskets shall be 1/8 inch on piece thick rubber, U.S. rubber rainbow or equal.

5.0 **MANUFACTURER:** ASME approved.

6.0 **NAME PLATE:** Affix to head an identification plate giving the following information:

Hydropneumatic Tank
Design Pressure 65 PSIG at 100 F
Estimated Weight Empty
Hydro-test Pressure 113 PSIG
Code Stamp - U

7.0 **SHOP DRAWINGS:** The tank manufacturer shall provide five (5) sets of shop drawings and design calculations for approval.

- 8.0 **FOUNDATION:** The tank shall be saddle-mounted on reinforced concrete foundations as shown on the plans.
- 9.0 **CONNECTIONS AND APPURTENANCES:** The tank shall be fitted with all connections and appurtenances as shown on the plans as follows:
- a. One (1) 14"x18" elliptical manway
 - b. Two (2) 1 inch 3000# connections for sight glass assembly
 - c. Lockable enclosure for sight glass assembly
 - d. One (1) 1 inch 3000# connection for air inlet
 - e. One (1) 1 inch 3000# connection for air relief valve
 - f. One (1) 6 inch flanged connection for water inlet
 - g. One (1) 4 inch flanged connection for tank drain
 - h. One (1) 12 inch flanged connection for ventilation opening
 - i. Lifting Lugs
- 10.0 **PAINTING:** The hydro-pneumatic tank shall be painted in accordance with Specification 225 of these specifications. Coatings shall conform to ANSI/NSF Standard 61 and be certified. Shop priming of the hydro-pneumatic tank will **not** be accepted in lieu of field priming.
- 11.0 **CLEANING AND DISINFECTION:** After construction and painting has been completed, the tank shall be cleaned and disinfected before being placed in service. The cleaning and disinfection of the tank shall be in accordance with Specification WP-275 of these specifications.
- 12.0 **AIR COMPRESSOR:** Provide an air compressor with an 80 gallon tank, motor, starter, hour meter, v-belt drive, and totally enclosed belt guard. The unit shall deliver 19.6 cfm at 100 psi. The compressor shall be driven by an electric motor of 5 horsepower, 460/480 volt, three phase, 60 Hz, at approximately 1750 rpm, suitable for continuous operation.

END OF SECTION

SPECIFICATION WP-225

PAINTING

1.01 SCOPE:

This section covers painting, surface preparation, protection of surfaces, testing and inspection. The Contractor shall furnish all materials, tools, equipment, and labor to paint the facility, including piping, machinery, miscellaneous metals, structures, and buildings, as shown on the drawings and specified herein. All coatings and solvents will be delivered to the job site in original, sealed, and labeled factory containers. All coatings shall be made by a single manufacturer and applied in strict accordance with the manufacturer's requirements and instructions.

2.01 PREVAILING REGULATORY REQUIREMENTS:

- A. It is the contractor's sole responsibility to protect the plant, equipment and environment while performing work under these technical specifications. In addition, it is the contractor's sole responsibility to provide a safe working environment for all individuals working in accordance with these technical specifications. Therefore, the contractor shall comply with all applicable requirements of the following regulatory agencies;

TNRCC	Texas Natural Resource Conservation Committee
TACB	Texas Air Control Board
HCHD	Harris County Health Department
EPA	Environmental Protection Agency
OSHA	Occupational Safety & Hazard Association
NSF	National Sanitation Foundation

- B. The contractor shall obtain all required permits in compliance with the above listed regulatory agencies in order to complete the surface preparations, application and the handling, removal and disposal of used abrasive, paint containers and any other trash generated during this subject project. In addition, if a permit is not required, then the contractor shall issue a letter to the District's engineer stating that the contractor has researched all regulatory agencies and that no permit(s) is required.

3.01 COLOR SELECTION:

The colors shall be selected from the manufacturer's standard color chart by the Owner.

- 4.01 MATERIAL HANDLING AND STORAGE: All paint shall be delivered to the job in original unopened containers with labels in tact. Paint shall be stored inside and shall be protected against freezing. No adulterant, unauthorized thinner or other material not included in the paint formulation shall be added to the paint for any purpose.

5.01 SHOP PAINTING: Valves and piping shall have shop paint removed by sandblasting (SSPC SP-10).

6.01 MIXING AND THINNING: Paint shall be thoroughly mixed when withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.

Unless otherwise authorized, all paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced by addition of paint thinner, or otherwise, below that represented by the recommended coverage rate.

7.01 SURFACE PREPARATION: All surfaces to be painted shall be dry and clean and shall meet or exceed the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces.

Oil and grease shall be completely removed by use of solvents or detergents.

Surfaces shall be free of cracks, pits, projections, or other imperfections which would prevent the formation of a smooth, unbroken paint film. Surface anchor pattern shall be 2.0 to 3.5 mil.

When applying touch-up paint, or repairing previously painted surfaces, the surfaces to be painted shall be cleaned and sanded or wire brushed in such a manner that the edges of adjacent paint are feathered or otherwise smoothed so that they will not be noticeable when painted. All paint made brittle or otherwise damaged by heat of welding shall be completely removed.

The surface preparation shall be in accordance with Steel Structures Painting Council Specifications as follows:

<u>SURFACE</u>	<u>SURFACE PREPARATION</u>
Tank Components, Piping Valves, Fittings & Misc. Steel	SSPC-SP-10
Galvanized & Non-Ferrous Metals	SSPC-SP-1 & 3
Concrete & Masonry	Remove efflorescence, chalk, dust, dirt, grease, oil, tar, excessive mortar, and free iron by brush-off blast, hand tool cleaning, and acid wash

Prepared surfaces shall be approved by the Engineer before applying the paint.

8.01 ENVIRONMENTAL CONDITIONS:

- A. Blasting or coating applications shall NOT take place in rain, snow, mist or fog. Blasting or coating operations shall not take place on a damp or wet surface. This includes the inside of the equipment as well.
- B. The metal temperature shall be above 50 degree F. prior to coating application. If it is expected to fall below 40 degrees F. within six hours after the anticipated application time, the coating shall not be applied.
- C. The relative humidity shall be below 85% as verified by the use of a sling psychrometer in conjunction with the US Department of Commerce Weather Bureau Psychrometric Tables. The ambient temperature shall be 5 degrees F. above the dew point listed in these tables.
- D. The maximum steel temperature that coating can be applied too shall be 125 degrees F.
- F. It is the responsibility of the contractor to confirm the above prior to commencing operations. If conditions are found unacceptable by the Site Representative, any work performed shall be rejected. If the conditions are border line, then the contractor shall discuss the conditions with the Site Representative prior to commencing operations.

9.01 APPLICATION:

Paint shall be applied in a neat manner, with finished surfaces free of runs, sags, ridges, laps, and brush marks. All weld seams and corners shall be stripe coated. Each paint coat shall be dry to the extent recommended by the manufacturer before the next coat is applied. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness. In no case shall paint be applied at a rate of coverage per gallon which is greater than the maximum rate recommended by the manufacturer.

Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the second field coat over previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.

10.01 REPAIRING DAMAGED PAINT:

Painted surfaces which have become damaged prior to acceptance by the Owner shall be repainted with the same or equivalent paint and methods used in the original application.

11.01 PROTECTION OF SURFACES:

Throughout the work the Contractor shall use drop cloths, masking tapes, and other suitable measures to protect all surfaces from accidental spraying, spattering, or spilling of paint. The Contractor shall be responsible for and shall correct and repair damage resulting from his operations or the operations of those responsible to him.

12.01 REMOVAL OF IMPROPER PAINT OR PAINT IMPROPERLY APPLIED:

All applied paint that does not conform to the requirements herein specified, or paint that has been applied on surfaces that have not been cleaned sufficiently or properly shall be thoroughly removed and the surfaces cleaned and repainted to the satisfaction of the Engineer, at the expense of the Contractor.

When the final field coat does not have a uniform color and appearance throughout the structure, it shall be corrected by the use of additional coats as may be necessary.

13.01 COATING SYSTEMS SCHEDULE:

A. TANKS

1. Interior:

1st Coat	Valspar 32-D-7
4.0-6.0 Mils (DFT)	Tnemec's Pota-Pox 140
Ameron's Amercoat 400 FD	
Acro's 4460 Epoxy	

2nd Coat	Valspar 32-W-3
4.0-6.0 Mils (DFT)	Tnemec's Pota-Pox 140
Ameron's Amercoat 400 FD	
Acro's 4460 Epoxy	

2. Exterior:

1st Coat	Valspar 13-R-62
4.0-6.0 Mils (DFT)	Tnemec's Series 65
Ameron's Amercoat 385	
Acro's 4422 Epoxy	

2nd Coat	Valspar V89-D-7
4.0-6.0 Mils (DFT)	Tnemec's Series 66
Ameron's Amercoat 385	
Acro's 4460 Epoxy	

3rd Coat	Valspar V40 Urethane
2.0-3.0 Mils (DFT)	Tnemec's Endura-Shield 74
Ameron's Amercoat 450GI	
Acro's 4429 Polyurethane	

B. PIPING, VALVES, MACHINERY & MISCELLANEOUS STEEL

1st Coat	Valspar 13-R-62
1.5-3.0 Mils (DFT)	Tnemec's Poly-Ura-Prime
Ameron's Amercoat 182 Primer	
Acro's 4422 Primer	

2nd Coat
1.5-3.0 Mils (DFT)
Ameron's Amercoat 182 Primer
Acro's 4422 Primer
Valspar V89 Epoxy
Tnemec's Poly-Ura-Prime

3rd Coat
1.0-2.0 Mils (DFT)
Ameron's Amercoat 450GL
Acro's 4429 Polyurethane
Valspar V40 Urethane
Tnemec's Endura-Shield 74

C. CONCRETE AND MASONRY (Interior & Exterior)

1st Coat
75-100 Sq.Ft./Gal.
Ameron's Amercoat 5625
Acro's 4453 Block Filler
Kopper's Concrete & Masonry Filler
Tnemec's Epoxy-Polyimide Filer 54-600

2nd Coat
75-100 Sq.Ft./Gal.
Ameron's Amerlock 400
Acro's 4460 Epoxy
Kopper's Hi-Build Epoxy
Tnemec's Hi-Build Epoxoline 66

3rd Coat
125-150 Sq.Ft./Gal.
Ameron's Amercoat 450GL
Acro's 4428 Polyurethane
Kopper's 1122 BRS
Tnemec's Endura-Shield 70

Maximum dry mill thickness shall not exceed 9 mils for first coat and second coat each.

14.01 INSPECTION & TESTING:

A. The contractor shall perform all required inspections prior to the site inspector performing inspection activities, to ensure that the area to be inspected is acceptable to project requirements. It is not the responsibility of the inspector to perform inspection activities for the contractor. Any area found unacceptable to the inspector shall be repaired at the expense of the contractor including the cost of the inspector. All testing shall be done in accordance with Section 8 of the latest edition of AWWA Standard Specifications D-102 or the latest revisions thereof.

B. The contractor is required to have on site at all times the required inspection and testing equipment. This shall include but is not limited to; wet film thickness gauge, dry film thickness gauge, micrometer and Testex tape, sling psychrometer, temperature gauge, US Department of Commerce Weather Bureau Psychrometer Tables, low voltage holiday detection equipment and any other equipment deemed necessary. The inspection equipment shall be calibrated prior to any inspection.

- C. The contractor and the inspector shall coordinate in advance of any work to be performed the timing of completion of the work in order for the project to continue in a timely manner. The following inspections, but not limited to, shall be performed by the contractor and the inspector;
1. The inspector shall take and record the environmental conditions with the contractor when he is on site,
 2. Inspection and approval of surface preparations prior to any coating,
 3. Inspection and approval of each coat prior to application of the next coat. Areas found unacceptable shall be repaired,
 4. Wet and dry film thickness measurements shall be performed at applicable times,
 5. Visual inspection of the entire surface to be coated,
 6. Holiday inspection after the coating has cured a minimum of seven (7) days at 75 degrees F. The coating manufacturer shall be consulted on the numbers of days required to wait prior to holiday inspection. Holiday inspection will be performed on immersed and non immersed surfaces inside the tank, special consideration around lap joint will be discussed at the pre-job meeting.
- D. To facilitate adequate examination of all surfaces, including the roof and shell surfaces, above the overflow pipe, center support column and above the rafters, the contractor shall supply scaffolding or rigging and adequate illumination required to perform all inspection activities. Personnel shall be made available to move the scaffolding or rigging.
- E. All inspection activities shall be performed in accordance with the requirements of SSPC and NACE.

15.01 FIRST ANNIVERSARY INSPECTION:

The Contractor shall perform first anniversary inspection in the presence of Owner's representative as per Section 9 of the latest edition of AWWA Standard Specification D-102.

16.01 SUBMITTALS

The contractor shall submit for approval by the engineer the following information;

1. Type of grit and how it will be stored,
2. Name of paint manufacturer, type of paint, trade name and number identifying each paint material, technical data sheets, Material Safety Data Sheets, color chart to allow final color to be selected by owner,

3. Proof of compliance with requirements for potable water contact,
4. Proof of compliance with the performance data listed in these specifications,
5. Proof of a lead free system

17.01 TOUCH-UP PAINT:

The Contractor shall provide 5 gallons of each paints used in unopened containers.

18.01 GUARANTEE

All work performed under these specifications shall be free of defects in either material or workmanship for a period of one (1) year after final acceptance.

19.01 CLEANING AND DISINFECTION:

After construction and painting has been completed, the tank shall be cleaned and disinfected before being placed in service. The cleaning and disinfection of the tank shall be in accordance with Specification 275 of these specifications.

20.01 MEASUREMENT AND PAYMENT:

Measurement will be lump sum basis for painting both the interior and exterior of the hydropneumatic tanks and shall be considered full compensation for providing all labor, equipment, materials, etc. necessary for a complete coating system.

END OF SECTION

SPECIFICATIONS 230

HORIZONTAL SPLIT CASE BOOSTER PUMPS

1.0 SCOPE: Furnish and install booster pumps as shown on the drawings and as specified herein. The pumps shall be horizontal split-case type with section and discharge connections located on the opposite sides in the lower half casing. The rotating elements shall be easily removable without disturbing piping. The pumps shall be as manufactured by Paco, American Marsh, or approved equal.

2.0 PUMP:

(a)

<u>Pump Performance:</u>	<u>B.P. 1</u>	<u>B.P. 2</u>	<u>B.P. 3</u>
1. Capacity GPM	1,000	1,000	1,000
2. T.D.H. Ft.	150	150	150
3. Discharge Dia. In. (Min)	10	10	10
4. Suction Dia. In. (Min)	12	12	12
5. Speed, r.p.m.	1,780	1,780	1,780
6. Efficiency, % (Min)	80%	80%	80%
7. Motor H.P.	60	60	60
8. Stages	Single	Single	Single

(b) Pump Casing: The casing shall be of cast iron free from blow holes, sand pockets and defects. The casing shall have a minimum tensile strength of 35,000 psi. The pump casing shall be designed of not less than 175 psi working pressure for water service at temperatures up to 250° F. The pump suction and discharge shall be equipped with flanges equivalent to ANSI B16.1, 125 lb. class for 175 psi working pressure pumps. Pump suction and discharge shall be equipped with drilled and tapped gauge ports. A manually operated petcock shall be installed on the vent tapping on the top of the casing. Removal of the upper half of the pump casing shall allow removal of the rotating element without disconnecting the suction and discharge piping.

(c) Pump Impeller: the impeller shall be of the enclosed type and shall be of vacuum cast bronze. The impeller shall be dynamically balanced and securely fastened to the shaft by key and shaft sleeves. The vanes shall be designed to reduce noise.

(d) Pump Shaft: the shaft shall be made of high grade SAE 1045 steel. The shaft shall be machined to give a true running rotating element. The shaft shall be adequately designed for the loads transmitted.

(e) Shaft Sleeves: The shaft shall be protected from wear by bronze or 416 stainless steel sleeves which are key locked and threaded so that the sleeves tighten with the rotation of the shaft. Teflon gaskets must be provided between the impeller hub and the shaft sleeves to prevent pumped liquid from corroding the shaft.

- (f) Casing Rings: The pump shall be equipped with easily removable bronze casing rings. The hydraulic pressure shall seat them against a shoulder in the pump case around the full periphery of the wearing ring.
- (g) Wear Rings: The wear rings shall be made of lead-free bronze, replaceable type, locked in place by dwelling to prevent rotation.
- (h) Bearings: The rotating element shall be mounted in heavy duty grease lubricated ball bearings and shall be equipped with water slingers on the side next to pump glands. The bearing housing shall be designed to provide continuous cleaning of bearing surfaces and maximum protection against overheating. The housing shall be of cast iron and shall be furnished with a set of regreaseable bearings for both radial and thrust loads. The bearings shall have an average life of 250,000 hours and shall be mounted in machined, moisture and dust proof housings. The housings shall have register fits and shall be bolted to the pump casing to insure permanent alignment.
- (I) Alignment: The pump and motor must be checked for alignment after the pump base has been installed and grouted in place, in accordance with the Hydraulic Institute Standards. There shall be no stress transmitted to the pumps.
- 3.0 **MOTOR**: The motor shall be the squirrel cage induction type, it shall be capable of operating on 480 volt, 60 hertz, 3 phase current. The enclosure shall be open drip proof. The motor shall be of sufficient capacity to operate the pump under all conditions on the characteristic curve without overloading. The service factor shall be 1.15. The pump shall be connected to the horizontal driving electric motor through a flexible coupling and the coupling shall have a formed sheet steel coupling guard mounted between the pump and motor and bolted to the base plate. The insulation shall be Class B type suitable for the Gulf Coast environment. A space heater shall be provided inside the motor. The motor shall be designed, constructed and tested in accordance with applicable IEEE, NEA and ANSI Standards. The motor shall be furnished by the pump manufacturer.
- 4.0 **SUBMITTAL**: Submit six (6) copies of complete descriptive data of the pump and driver, including, but not limited to: certified pump curves, NPSH requirements, horsepower requirements, materials, of construction for all components of the pump, complete description of the driver including horsepower, electrical characteristics, bearing life ratings, insulation ratings, dimensional drawings, operation and the maintenance manuals and spare parts list.
- 5.0 **FACTORY TESTS**: The pumps shall be given an operational test at the factory to check for excessive vibration and for leaks in all seals. The pump suction and discharge lines shall be coupled to a reservoir and the pump shall recirculate water for at least one hour under simulated service conditions.
- 6.0 **GUARANTEE**: The pumps and motors shall be guaranteed against defects in workmanship and material for one year from the date of acceptance by the Owner.
- 7.0 **NAME PLATES**: Pups and motors shall have a standard name plate security affixed

thereto in conspicuous place showing serial number and name of manufacturer. In addition, the pump name plate shall show capacity in gallons per minute at rated speed in revolutions per minute and head in feet; and the motor name plate shall show minimum amount of information per NEMA MG 1-10.38. Name plate of a distribution agent only will not be acceptable.

END OF SECTION

SPECIFICATION WP-240

CHLORINATION SYSTEM

1.01 GENERAL:

The Contractor shall furnish all transportation, labor, materials, equipment and supervision required to furnish and install the proposed new chlorination equipment, piping, and appurtenances complete as shown on the plans and specified herein. Acceptable manufacturer is Wallace & Tiernan.

2.01 SCOPE:

The Contractor's work to be performed under this section shall include furnishing and installing the proposed chlorination system consisting of: two (2) remote vacuum type chlorinators, two (2) vacuum regulator check units with automatic and manual switchover and filter trap assemblies, chlorine cylinder scales, four (4) stainless steel (316) safety chains for auxiliary cylinders, four (4) flexible polyethylene gas cylinder connectors, Schedule 80 PVC chlorine solution and water supply pipe, valves and fittings, flexible polyethylene gas vent tubing with stainless steel screen outlet, one (1) chlorine gas leak detector with local and remote alarm indicator lights, automatic vent fan control circuits and maintenance kit, self-contained breathing apparatus with storage cabinet, and miscellaneous appurtenances as shown on the plans and as specified herein.

- A. Chlorinators: The Contractor shall furnish and install two (2) remote vacuum chlorinators in the proposed chlorine room as shown on the plans and as specified herein. The chlorinators shall be Wallace & Tiernan Series V-75VA2 with 50 lbs/day rotometers and injector throat assemblies. The system shall be designed for manual feed rate control and for automatic start/stop operation. The chlorinators shall be capable of injecting up to 5 mg/l with a 10:1 turn down ratio. The Contractor shall provide one (1) spare 100 lbs/day rotometer and injector throat assembly and complete spare parts kits for each chlorinator. The Contractor shall furnish and install chlorine gas polyethylene vent tubing with stainless steel screened outlet from the pressure relief valves to the building exterior.
- B. Automatic Switchover Vacuum Regulator Check Unit: The Contractor shall furnish and install two (2) container mounted automatic switchover vacuum regulator check units (The Regulators) complete with trap and filter assemblies. The automatic switchover shall automatically change the chlorine supply from the operating bank of cylinders to the standby bank of cylinders when the operating supply becomes exhausted. The Regulators shall be Wallace & Tiernan Model No. 200C with filter trap assemblies Wallace & Tiernan No. G1123.
- C. Chlorine Gas Piping: The contractor shall furnish and install chlorine gas manifolds, chlorine gas piping, chlorine cylinder flexible connectors, piping supports and hangers and appurtenances as shown on the plans and as specified herein. The chlorine gas manifold shall be fabricated of schedule 80 PVC threaded pipe and screwed fittings.

The Contractor shall furnish and install chlorine header valves at each manifold inlet and captive yoke auxiliary cylinder valves as shown on the plans and specified herein. The Contractor shall furnish and install two (2) flexible connection lines (3/8" x 1/2" polyethylene tubing). The Contractor shall furnish and install schedule 80 PVC chlorine gas supply piping from the manifold to the chlorinators complete as shown on the plans and specified herein. The chlorine gas valves shall be schedule 80 PVC True Union threaded ball valves and the fittings shall be schedule 80 PVC threaded. The Contractor shall furnish and install pipe supports and hangers as required to properly (substantially) support all piping provided in this section. The pipe supports shall be Grinnell Fig. 138R with base plates Fig. 128R, machine threaded hanger rods and Phillips Concrete Fasteners No. FH-338.

- D. Chlorine Solution and Water Supply Piping: The Contractor shall furnish and install Schedule 80 threaded PVC chlorine solution and water supply pipe, valves, and fittings as shown on the plans and specified herein. The valves shall be Hayward Safe Block True Union PVC threaded ball check valves. The solenoid control valve shall be Plast-O-Matic Model No. EASMD6EP22W28 PVC threaded solenoid valve. The wye strainer shall be Hayward PVC threaded with Type 316 stainless steel 40 mesh screen. The booster pump pressure regulator valve shall be Plast-O-Matic Model No. PR0150V PVC threaded pressure regulator valve. The booster pump pressure relief valve shall be Plast-O-Matic Model No. RVT 150V-PV PVC threaded pressure relief valve. The water supply pressure gage shall be Ashcroft Model No. 35-1009-SWL-02L with a range of 0-160 psi.
- E. Chlorine Cylinder Scale: The chlorine cylinder scales are to be Wallace & Tiernan Series 50-345. Operating and standby cylinders shall have separate scales. The Contractor shall take care to protect the scale until installation.
- F. Chlorine Gas Leak Detector: The Contractor shall furnish and install one (1) chlorine gas leak detector complete with PVC conduit, wire, alarm light, auxiliary alarm contacts and vent fan auxiliary contacts as shown on the plans and specified herein. The detector shall be Wallace & Tiernan Series 50-135 Chlorine Gas Detector. The detector shall be wall-mounted in the chlorinator room and the electrode assembly shall be remote wall-mounted in the chlorine storage room in accordance with the manufacturer's recommendations. The Contractor shall furnish one (1) lot of spare parts to include electrolyte, fuses and lamps. The proposed supply fans shall be energized by a warning contact and the proposed alarm light shall be energized by an alarm contact.

3.01 MATERIALS:

All materials used in the plant shall be in accordance with the standards of the American Society for Testing and Materials, American Water Works Association, Texas Commission on Environmental Quality, and the American National Standard Institute as they may apply to the materials used in the construction of this facility. In all cases, the material of construction and the equipment to be installed shall be new and undamaged in shipment or installation.

4.01 WORKMANSHIP:

In all phases of the work only competent, certified, skilled mechanics shall be employed and the work shall be in accordance with the Standard and Specifications as set out herein.

5.01 REFERENCE STANDARDS:

All work and materials under this section shall conform to the requirements of the Texas State Department of Health, American Society for Testing and Materials, National Electrical Code, National Fire Protection Association, National Electrical Manufacturers Association, Underwriter's Laboratories, American National Standards Institute, Occupational Safety and Health Agency, The Chlorine Institute, Inc. and all local ordinances.

6.01 DRAWINGS:

- A. The Contractor shall review all pertinent drawings and adjust his work to the conditions shown thereon. Discrepancies between drawings, specifications, and actual field conditions shall be brought to the prompt attention of the Engineer.
- B. The drawings indicate the approximate locations of existing and proposed power outlets, feeders, branch circuits, panel boards, etc. The exact location of these items shall be determined by measurement in the field from building lines. Such locations will, at all times, be subject to the approval of the Engineer.

The Engineer reserves the right to make any reasonable change in the outlet locations indicated, without any additional cost to the Owner.

7.01 MANUFACTURER:

All chlorination equipment shall be furnished by a single manufacturer. The manufacturer's representative shall inspect the equipment after the installation is complete, make all necessary adjustments to the equipment, and provide 8 hours of continuing instruction to the operator in proper operation and maintenance. The chlorination equipment shall be manufactured by Wallace & Tiernan.

8.01 SUBMITTALS:

The Contractor shall submit, (5) five sets of drawings for review by the Engineer. The information shall include performance data, piping schematics, and detailed installation instructions and drawings.

9.01 SUBSTITUTION:

Bidders are cautioned to obtain approval of other than the Specified System. The Contractor shall submit written modification outlining in detail the substitutions proposed to the Engineer seven work days prior to bid. The contractor shall state

advantages, including price allowance and operational advantages for substitutions. An addendum will be issued if acceptable. If use of substitution requires changes or modifications in plans, the Contractor will reimburse the Engineer for cost of such changes.

10.01 UNIT RESPONSIBILITY:

Substitutions accepted by the Engineer shall not relieve the Contractor of the responsibility of furnishing an operational system and if a substitute system fails to perform as required, and is judged faulty, solely at the discretion of the Engineer, the Contractor will be required to remove the substitute system and to install the originally specified system at no additional cost to the Owner.

11.01 OPERATION AND MAINTENANCE INSTRUCTIONS:

The Contractor shall furnish four (4) copies of instruction books, diagrams (including shop drawings), and parts lists with manufacturer's identifying symbols covering all items of equipment furnished. Each of the appropriate publications and drawings shall be placed in binders with each item properly indexed and delivered to the Engineer before final acceptance of work.

12.01 TESTING AND START-UP:

The chlorination system equipment shall be tested prior to being placed in operation. The Contractor shall provide the services of a competent engineer or technician for a minimum of 8 hours for initial start-up and checking out of the equipment installation and its operation. In addition, the manufacturer's representative shall visit the installation at least once during each three month period for a period of one (1) year after start-up to check on and report to the Owner the condition of the equipment and make any adjustments necessary at no extra cost to the Owner.

13.01 GUARANTEE:

All materials, equipment, and appurtenances shall be guaranteed against defects in material and workmanship for a period one (1) year from the date of acceptance by the Owner.

14.01 MEASUREMENT AND PAYMENT:

The various items and work described herein shall not be measured. Payment for items and work described herein shall be made under the Lump Sum Price Bid, for "CHLORINATION SYSTEM", and shall include all labor, supervision, equipment, materials, and incidental items necessary to complete the work as shown on the plans and described in these specifications.

END OF SECTION

SPECIFICATION WP-275

CLEANING AND DISINFECTION

1.01 GENERAL REQUIREMENTS:

This work includes furnishing equipment, materials and labor necessary to disinfect and clean the proposed facilities constructed under this contract.

All portions of the project intended to hold or handle potable water shall be disinfected.

2.01 CONSTRUCTION PRECAUTIONS:

During construction, take all measures necessary to keep and maintain the work as clean as possible. Keep interior of all piping free of foreign matter, rodents and dirt at all times. When not being worked, plug or cap all incomplete piping.

3.01 CLEANING PROCEDURES: Clean the interior of all tanks by scrubbing with rags or approved brushes, followed by hosing down with approved water. The piping system shall not be flushed prior to disinfection.

4.01 DISINFECTION:

- A. Materials: The material used for disinfection shall be a chlorine gas-water mixture, calcium hypochlorite in water or chlorinated lime.
- B. Methods: Comply with applicable sections of AWWA C601-81.
- C. Piping Systems: Proceed as follows or as otherwise approved by the Engineer.
 - 1. Complete hydrostatic tests prior to disinfection.
 - 2. Fill the system with water having a minimum of 100 mg/1 of chlorine and retain it for 24 hours. The minimum free chlorine residual shall not be less than 50 mg/1 after 24 hours.
 - 3. Flush the treated water from the piping system until replacement water has chlorine content of no more than 0.01 mg/L in excess of the chlorine content of the supply water.

5.01 TESTING AND DISPOSAL OF CHLORINATED WATER:

- A. After completing the disinfection procedures, water from all units shall be sampled and samples submitted for bacteriological analysis. Any unit whose sample shows presence of objectionable coliform organism shall be disinfected again.
- B. Chlorinated water shall be disposed of properly. The system and tank shall not be placed in operation until the disinfection has been approved by the Engineer.

6.01 MEASUREMENT AND PAYMENT: The work performed under this specification will not be measured. No extra payment will be made for "Cleaning and Disinfection", the cost to be included in the bid price for the items requiring sterilization.

END OF SECTION

SPECIFICATION WP-241

FLUORIDATION SYSTEM

1.0 GENERAL

The Contractor shall furnish all transportation, labor, materials, equipment and supervision required to furnish and install the proposed new fluoridation equipment, piping, and appurtenances complete as shown on the plans and specified herein.

2.0 REFERENCE DOCUMENTS

a. The public water system owner, contractor, and equipment supplier and/or manufacturer shall consider and apply the most recent issue of the applicable standards and codes issued by the following associations and approval bodies as part of this specification.

- Uniform Building Code (UBC)
- Standard Building Code (SBC)
- Uniform Plumbing Code (UPC); Southern Standard Plumbing Code; National Standard Plumbing Code
- National Fire Protection Association (NFPA), NFPA 70 National Electrical Code
- United States Department of Labor - Occupational Safety and Health Administration (OSHA) CFR Part 1910
- American Water Works Association (AWWA), Water Fluoridation Principles and Practices, Manual M4
- ANSI/AWWA Standard for Hydrofluosilicic Acid, B703-00
- Morbidity and Mortality Weekly Report (MMWR), Engineering and Administrative Recommendations for Water Fluoridation, 1995, U.S. CDC, September 29, 1995/Vol. 44/No. RR-13
- ANSI/ASME B31 Piping Code
- ANSI Z358.1-1998 American National Standard for Emergency Eyewash and Shower Equipment
- Title 30, Part I, Texas Administrative Code (TAC), Chapter 290, Subchapter D, Rules and Regulations for Public Water Systems

3.0 SCOPE

3.1 Item Definition.

3.1.1 General

- a. The fluorosilicic acid system stores, pumps, and injects fluorosilicic acid into piping systems in public water systems at the volumes and pressures required by the project specifications.
- b. All chemicals used in treatment of water supplied by public water systems must

conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 60 for direct additives and ANSI/NSF Standard 61 for indirect additives. Conformance with these standards must be obtained by certification of the product by an organization accredited by ANSI.

c. The fluorosilicic acid system includes the following major equipment items, components and appurtenances.

- Bulk storage tank and/or carboy/drum storage
- Fluorosilicic acid transfer pump in the bulk tank or drum storage
- Fluorosilicic acid day tank
- Scale for day tank weight measurement
- Fluorosilicic acid chemical metering injection pump
- Piping, tubing, and valves
- Wiring
- Instrumentation
- Secondary containment systems
- Safety equipment
- Test equipment
- Foundations and enclosures (as required)

3.1.2 High point vents: High point vents are valved piping outlets located at high points in piping and equipment for operation, maintenance or testing.

3.1.3 Low point drains: Low point drains are valved piping outlets located at low points in piping and equipment for operation, maintenance or testing.

3.2 Characteristics.

3.2.1 Performance

- a. The fluorosilicic acid system shall be designed for continuous service.
- b. The system shall be sized and rated to provide the maximum and minimum injection pressures over the full range of specified injection rates.
- c. Injection pump accuracy shall be plus or minus 1 percent between 10 and 100 percent of the rated flow rate.

3.2.2 Physical characteristics.

- a. In systems with bulk storage tanks, the tank size and height conforms to the physical size limitations and availability of the acid transfer pump. Containment facilities for a single container must be large enough to hold the maximum amount of chemical that can be stored with a minimum freeboard of six vertical inches or to hold 110% of the total volume of the container, whichever is less.
- b. Secondary containment systems shall be used to contain uncontrolled releases of fluorosilicic acid during operations and maintenance activities.
- c. Personnel protection equipment such as gloves, jackets, goggles, and face shields, etc. shall be provided at all times for the safe handling of fluorosilicic acid.

3.2.3 Maintainability.

- a. The fluorosilicic acid system shall be designed and constructed for ease of maintenance, repair, and modifications to the system components.
- b. Adequate space shall be provided for access to and maintenance of all system components without removing any major assembly.

3.3 Design and Construction.

3.3.1 General.

- a. The system shall be designed and orientated to facilitate interconnection with the water system at the point where the fluorosilicic acid is introduced into the water treatment process.
- b. The system shall be supplied complete with any support structures, piping, valves, safety equipment, and any other features necessary to ensure safe operation. Placing the system into service shall only require connection to external electrical circuits and designating the point at which the fluorosilicic acid is introduced into the water treatment process.
- c. The bulk storage tank shall be set on a suitable concrete foundation designed for the soil conditions, wind loading, and other environmental factors unique to that water treatment facility.

3.3.2 Materials.

- a. Construction materials shall be in accordance with the General Specifications (GS), the approved equipment components, approved vendors, data sheets, and drawings associated with the project, and shall be suitable for the intended chemical service and environmental conditions.
- b. All metallic components wetted by the fluorosilicic acid shall be of Hastelloy-C 276, Carpenter 400, or Monel 400 Series material. Non-wetted metallic components shall be of Type 304 or Type 316SS material.

3.3.3 Bulk Storage Tank (when specified on drawings).

- a. The bulk storage tank shall be an ASTM D 1998 Type 1 tank constructed of virgin high-density cross-linkable polyethylene.
- b. The bulk storage tank shall be lined internally with a NSF/ANSI 61 Certified oxidation resistance system.
- c. The bulk storage tank shall be designed and oriented to facilitate interconnection with other equipment and piping associated with the fluoridation system.
- d. The bulk storage tank shall be supplied complete with a stairway or ladder, work platform, landing, handrails, any support structures, piping, tank fittings, safety features, and other features necessary to ensure safe operation.
- e. The bulk storage tank shall be placed on a smooth concrete pad or foundation.
- f. The tank shall have the capacity stated on the drawings.
- g. The bulk storage tank shall have, at a minimum, the following appurtenances and

accessories.

- Fill, transfer pump, pressure/vacuum vent connections as specified on the tank data sheet.
 - Level transmitter connection
 - 24, 19, or 10 inch Manway
 - Secondary containment tank drain connection
- h. All appurtenances and fittings installed in the inner tank shall be through the closed dome top only. The outer containment shell shall contain only one bulkhead fitting with drain valve located as low as possible to the knuckle radius of the outer tank.

3.3.4 Polyethylene Carboys/Drums, (when specified on the drawings as the form of bulk storage).

- a. Closed-Head polyethylene drums shall be equipped with two bung outlets, (1) 2 inch NPT and (1) 2 inch buttress opening with 3/4 inch NPT center reducer.
- b. A vent connection tie-in shall be provided at the 3/4 inch NPT center reducer of the 2- inch buttress connection to the fluoridation system external vent.
- c. A suitable fluorosilicic acid transfer drum pump shall be installed in the 2-inch NPT opening.
- d. The carboy/drum shall be placed on the secondary containment drum storage pallet using suitable material handling equipment.

3.3.5 Bulk Storage Tank Fluorosilicic Acid Transfer Pump and Motor.

3.3.5.1 Transfer Pump.

- a. Unless otherwise specified, the transfer pump shall be of the tube style vertical centrifugal pump with axial flow type prop impeller and a mechanical seal.
- b. The pump shall be equipped with a polypropylene mechanical seal with plasma coated lower shaft and plasma-coated seal.
- c. The wetted parts of the mechanical seal tube set shall be of polypropylene, Viton, carbon, Tefzel, ceramic, Hastelloy C and PTFE components to operate submerged in fluorosilicic acid. The tubeset shall be of polypropylene construction with a diameter of 1.875 inches.

3.3.5.2 Motor Driver.

- a. Motor shall be single-phase, 60-Hertz, totally enclosed, fan cooled, and induction motor.
- b. The motor shall be splash proof and supplied with a corrosion resistant coating suitable for corrosive environments.
- c. Motor shall have a built-in overload protection switch.
- d. Motor rating shall exceed the maximum expected pump horsepower requirements including losses.

3.3.6 Carboy/Drum Fluorosilicic Acid Transfer Pump.

3.3.6.1 Hand Pump.

- a. The body and shaft of hand pumps shall be of PVC, PVDF, or high-density polyethylene construction.
- b. Valves and seals shall be of Teflon and/or Viton suitable for fluorosilicic acid service.
- c. Transfer hose shall be of polyethylene construction and connected to the fluorosilicic acid system day tank using suitable stainless steel hose clamps.

3.3.6.2 Motor Driven Drum Pump.

- a. Electric motor driven drum and container pumps used for the transfer of fluorosilicic acid shall be supplied in accordance with Sections 3.3.5.1 and 3.3.5.2.

3.3.7 Day Tank.

3.3.7.1 Closed Head Day Tanks, 60-Gallon and Larger (DSHS Fluoride Day Tank)

- a. Closed-head molded day tanks shall be of cross-linked or high-density linear polyethylene construction and consist of a tank with a 5-inch to 10-inch threaded lid, non-vented with gasket, and straight bulkhead fittings for equipment connections from the top only. No side penetrations are permitted. Tank capacity shall be as specified per the project drawings and equipment specifications. Tank color shall be natural or translucent.
- b. The capacity of the tank for each nominal outside diameter tank size shall vary as a function of height up to a maximum overall height of 42 inches.
- c. The day tank top shall be equipped with a 2-inch tank fill connection for acid transfer, a 1-1/2 inch pump suction/pump relief tubing with tee installation, for each process chemical injection pump, and (1) 1-inch connection installation for tank vent.
- d. The day tanks shall be of double containment type construction or the day tank shall be set in a suitable open top tank with a capacity of at least 110% of the capacity of the day tank. Day tanks shall always be set on a scale that is used to record the daily usage of fluoride.
- e. The foot valve of the pump suction supply tube, with tube straighteners, shall be installed 1-inch from the bottom of the day tank, and no more than 3 days of acid shall be present in the tank. The amount stored in the day tank shall vary with seasonal usage such that it contains the 3-day maximum during a period. If tank stability problems are noted, then the suction tube can be shortened and the same 3-day maximum of acid shall be supplied above the foot valve, which is above some quantity of acid in the tank added for stability. The shortened suction tube effectively limits the amount of acid available for injection.

3.3.7.2 Closed Head Drums/Carboys, 15-Gallon to 55-Gallon,

- a. Closed-Head polyethylene drums shall be equipped with two bung outlets, (1) 2 inch NPT and (1) 2 inch buttress opening with 3/4 inch NPT center reducer. Tank capacity shall be as specified per the project drawings and equipment specifications. Tank

- color shall be natural or translucent.
- b. A tank connection tie-in shall be provided at the 3/4 inch NPT center reducer of the 2- inch buttress opening.
 - c. The day tank shall be placed on the scale, which sits on the secondary containment drum storage pallet or day tank shall be set in an open top containment tank and placed on the scale.
 - d. The 2-inch NPT opening drum bung shall be replaced with the fluorosilicic acid pump suction/tank vent/ and spare pump relief tubing installation.
 - e. The foot valve and tube straightener of the pump suction supply tube shall be installed at the bottom of the day tank and no more than 3 days of acid shall be present in the tank. If tank stability problems are noted, then the suction tube can be shortened and the same 3-day maximum of acid shall be supplied above the foot valve, which is above some quantity of acid in the tank added for stability. The shortened suction tube effectively limits the amount of acid available for injection.

3.3.8 Scale.

- a. Unless otherwise specified, the scale shall be of the portable platform beam type suitable for industrial and commercial duty.
- b. Platform beam type scale capacity shall be 500 or 1000 lbs. Beam graduations shall be in 50 LB or 100 LB increments with an accuracy of +/- 4 ounces or +/- 8 ounces.

3.3.9 Fluorosilicic Acid Chemical Injection-Metering Pump

- a. Unless otherwise specified by the drawings, the fluorosilicic acid chemical injection-metering pump shall be a positive displacement electronic solenoid type diaphragm-metering pump.

3.3.9.1 Electronic Solenoid Type Diaphragm-Metering Pump

- a. The metering pump should be sized to feed fluoride near the midpoint of its operating range. The pump should be sized to operate 30% to 70% of capacity.
- b. The pump capacity should be limited to a maximum adjusted fluoride level of 2 mg/l when calculated for the annual average water production rate.
- c. The pump volume shall be adjustable while in operation from zero to maximum capacity.
- d. Unless otherwise specified, the capacity adjustment shall be by readily accessible dial type knobs, one for changing the pump stroke length and the other for changing the stroke frequency. Both knobs shall be located opposite of the fluid end. On-off switch shall be integral with the frequency control knob.
- e. The pump drive shall be totally enclosed with no moving parts. The solid-state electronic pulser shall be fully encapsulated with no exposed circuits. The pump electronics shall be housed in a splashproof chemical resistant housing.
- f. The pump shall stop pulsating when the discharge pressure exceeds 35% of the pressure rating.
- g. Materials of construction:

- Head and Fittings: Acrylic/PVDF
 - Ball type check valves: PTFE/Teflon
 - Diaphragm: Hypalon
 - Check valve: Hypalon
- h. Unless otherwise specified, each pump shall be supplied with a 4-Function Valve, or approved equal, that provides 1) positive diaphragm-type anti-siphon, 2) 20 PSI continuous backpressure, 3) line depressurization/priming, and 4) pressure relief.

3.3.10 Piping.

3.3.10.1 General.

- a. Piping and valves shall be constructed of non-metallic components unless otherwise specified by the project specifications or project drawings.
- b. Piping and tubing shall be firmly fixed in a neat and orderly arrangement and shall not obstruct access for maintenance, operation, or adjustment of any equipment as shown on the drawings.
- c. Supports shall be designed and positioned to provide maximum protection against mechanical impact, vibration, or maintenance.
- d. Plastic piping and tubing shall be stored, handled, and joined in accordance with the instructions and procedures of the pipe or tubing manufacturer.
- e. Piping and double containment pipe systems located overhead of common work areas and/or worker egress areas such as walkways, doorways, stairways, etc. shall utilize metallic piping components suitable for wetting by fluorosilicic acid per Section 3.3.2 or be encased by a metal jacket. Non-metallic piping and double containment pipe systems may be incased by a carbon or stainless steel pipe jacket in straight runs that provide safe egress. Metallic piping or jackets shall be used to provide personnel protection in the event of fire and to provide mechanical guarding of non-metallic components in overhead locations.
- f. Removable fabricated metal mechanical guards shall be used on non-metallic piping systems to cover tubing, valves, piping components, and piping that is not incased by a secondary containment line wherever it is subject to mechanical damage by impact at locations exposed to personnel or could present an environmental hazard. This requirement does not apply at the discharge manifold of the metering pumps unless operating conditions warrant mechanical guarding. Transitions from below ground to above ground shall be mechanically guarded if piping or piping components are subject to mechanical damage by impact at locations exposed to personnel or present an environmental hazard.

3.3.10.2 Vents and Drains.

- a. Low point connections, each with a valve, shall be located at low spots in piping to facilitate flushing and draining. Valved drain connections shall be installed on equipment or piping that is not self-draining.

- b. High point vent connections, each with a valve, shall be located at high spots where gas or vapor may be trapped to vent accumulations and to facilitate flushing and draining operations.
- c. Day tank and drum/carboy vent lines shall be installed with sufficient slope and placement to freely drain back into the tank with out forming a liquid seal.
- d. Vent and drain connections operated only during shutdown or maintenance operations shall be provided with a suitable plug or blank.

3.3.11 Ladders, Cages, Stairs, and Handrails.

3.3.11.1 General

- a. Design, fabrication, and erection of ladders, cages, stairs, and handrails for bulk storage tanks shall be in accordance with applicable OSHA and ASTM requirements, project specifications, and the following additional requirements.
- b. Stairways or ladders shall be self-supporting.
- c. The top of the stairway or ladder landing shall be 30 inches below the elevation of the top of the outer containment tank shell if no runway or manway exists; else the top of the landing shall be 30 inches below the tank runway elevation with man way.
- d. Treads: All steel and fiberglass stairs shall have treads made of grating. All treads shall have an even distinctive leading edge with nosing of a non-slip design. Nosing shall extend 1/2 to 1 inch over the leading edge of a tread.
- e. The greatest rise height within any flight of stairs shall not exceed the smallest by more than 3/8-inch, (provide uniform rise height between treads). This requirement includes rise height between top or bottom tread and platform, floor, or landing.
- f. Clear Pathway: A 2 ft. - 6 in. minimum width is required for egress stairway and ladder stiles.
- g. Bottom Landing: A 2 ft. — 6 in. X 2ft. — 6 in. minimum landing area is required at the base of a stairway or ladder.
- h. Top Landing/Tank Platform: A 3 ft. — 6 in. X 3 ft. — 6 in. minimum landing/tank platform is required at the top of a stairway or ladder where access to the top of a tank is required for maintenance operations. The platform profile adjacent to the tank shall conform to the radius of the tank.
- i. Unless otherwise specified, the rise/run combination shall be 7-3/4 in. rise height/9-3/4 in. tread run (38 degrees — 29 minutes).
- j. Ladders, cages, stairs, and handrails shall be fabricated from either hot-dipped galvanized steel in accordance with ASTM A123, Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip or fabricated from hot-dipped galvanized steel with fiberglass grating components, or fabricated using structural members and grating of fiberglass construction, or fabricated from steel that is sandblasted to near white and painted with an acid resistant two part epoxy coating system.

3.3.12 Electrical Control of Chemical Injection Metering Pumps

3.3.12.1 General

- a. The fluoride chemical injection-metering pump shall be electrically interlocked, in series, with the ground source water well or water treatment plant (WTP) control circuit such that the fluoride metering pump cannot operate unless water is being produced.

Typical well or water treatment plant control systems include the following:

- a) Ground source water well pump motor control,
- b) Ground source water well flow control valve with actuator position detection circuit for artesian flow control,
- c) Raw water service pump(s) control circuit at a water treatment plant,
- d) WTP raw water inlet control valve actuator position detection circuit,
- e) A flow meter with flow controller or flow meter with intelligent control (PLC or SCADA) that detects a minimum flow condition on a ground source water well or detects the flow of raw water supply to a surface water WTP.

In all cases, the metering pump shall be electrically interlocked to inject fluorosilicic acid only when the well or water treatment plant control system indicates that water is being produced for treatment.

- b. Unless otherwise specified, all ground water sources produced by artificial lift (pump) or by artesian flow that have a dedicated fluorosilicic acid chemical injection-metering pump shall have a secondary flow-based electrical interlocked control circuit in addition to the requirements listed in 3.3.12.1a. The secondary interlock shall be electrically wired, in series, to detect/verify the flow of water before the metering pump operates. Allowed flow detection techniques include the following: a) thermal or paddle type flow switch, b) pressure actuated switch (mounted downstream of any block valves and check valves on the discharge of a pump), or c) a flow meter with flow controller or flow meter with intelligent control (PLC or SCADA) that detects a minimum flow condition. An exception to this requirement may be granted for those installations where the ground water source discharges into an above ground storage tank/clearwell. Ground water sources discharging directly into a public water supply distribution system shall have a secondary flow-based electrical interlock.
- c. It shall be physically impossible to plug a fluoride chemical injection-metering pump into any continuously active ("hot") electrical outlet. If the metering pump is not hardwired directly into the electrical circuit providing interlock protection to the well or service pump, then the metering pump shall be equipped with a **special**, clearly labeled plug (6-15P or 6-20P) that is compatible only with a special outlet (6-15R and/or 6-20R) on a dedicated interlocked electrical control circuit. Note that a 6-20R receptacle accepts either a 6-15P or 6-20P plug, and that a 6-15R receptacle accepts only a 6-15P plug.

3.3.12.2 Power Supply Requirements for Chemical Injection-Metering Pumps

- a. Fluoridation systems with **two or less** metering pumps shall provide an enclosure, each with one single gang plug outlet receptacle (socket) for connection of the metering pump power plug with one two-position selector switch and one momentary contact push button. This installation is typical of systems with one fluorosilicic acid injection point where one pump is used for injection service with

one 100% spare pump, or no spare pump. The outlet and switches shall be installed in a NEMA 12 enclosure. A NEMA approved drip proof cover shall be supplied over the socket receptacle outlet for installations subject to rain exposure, drips, or water splash. One outlet shall be designated as the "interlock protected circuit", with power to that socket controlled by a heavy-duty two-position selector switch (ON/OFF). The "interlock protected circuit" shall be hardwired directly to the dedicated electrical interlock circuit used for metering pump control specified in Section 3.3.12.1. The other receptacle outlet shall be designated as the "test circuit" with power to that socket controlled only by depressing a momentary contact pushbutton. The test circuit outlet receptacle shall not be capable of being supplied with continuously active power or "hot"; to power the test circuit requires the momentary contact button to be depressed by the operator.

- b. Fluoridation systems with **three or more** metering pumps shall provide an enclosure, each with one single gang receptacle socket outlet for connection of the metering pump power plug with one two-position selector switch and one momentary contact push button **for each pump that is used to continuously inject fluorosilicic acid**. The spare pump does not require a dedicated enclosure. The power supply cord for each spare pump shall be of sufficient length to plug into the interlock controlled power supply circuit of the "failed" metering pump. The installation of each dedicated power supply enclosure shall be in accordance with the requirements of Section 3.3.12.2.a.
- c. Electrical wiring and installation inside the control panel shall conform to the requirements of NFPA 70, National Electric Code (NEC).
- d. Internal panel wiring shall be installed by the control panel vendor.
- e. Switches (operator interfaces) and push buttons shall meet the requirements for NEMA A600 heavy-duty oil-tight switches. Rating for all switch components: 600 VAC, 10 Ampere continuous rating. Panel mounted devices such as switches, lamps, and push buttons shall be waterproof, dust-tight, and corrosion resistant. Push button: Momentary contact, size: 30-mm; 1-3/8 inch diameter mushroom head; color: red; guard: full with plastic or metal guard; legend plate: black with white letters, markings: Push to Run; contact block shall be fitted with a minimum of 1-normally open and one normally closed spare contact.

Selector Switch: Contact maintained, non-illuminated; size: 30-mm; color: black; selector position: left-contact open (OFF), right-contact closed (ON); knob type: standard or extended flag (gloved hand); legend plate: black with white letters, markings: Off-On, size: 2-1/4 inch square.

3.3.12.3 Receptacles.

- a. Outdoor receptacles shall be mounted 2 feet above the operating floor or platform. Indoor convenience receptacles shall be mounted 18 inches above the floor.
- b. One duplex 120-volt, 60-Hertz convenience receptacle shall be provided for maintenance purposes within 5 feet of the control panel.
- c. Receptacles that supply power for portable hand power tools or are outdoor receptacles shall have ground fault interrupters for personnel safety.

3.3.12.4 Pull-Points.

- a. Pull-points shall be installed so that no conduit run or secondary containment-piping run has more than four 90-degree bends, or four equivalent 90-degree bends.
- b. If conduit runs exceed the equivalent of a 200-foot straight run or contain more than the equivalent of three 90-degree bends, then pull fittings and junction boxes or other suitable approved techniques shall be provided to reduce pulling forces. One 90-degree bend shall be considered equivalent to 50 feet of straight run pipe or conduit.

3.3.13 Workmanship.

- a. Workmanship by the Contractor shall be in accordance with these project specifications and applicable project drawings.
- b. Unless otherwise specified, the Contractor shall comply with all applicable industry standards except where applicable project specifications and drawings define tolerances, procedures, processes or other requirements that exceed the industry standard.
- c. The Contractor shall comply with all published manufacturer's instructions or documentation in full detail, including each in-step process or procedure sequence specified or recommended by the manufacturer of the component or equipment item.
- d. Any conflicts or discrepancies among the specifications or procedures shall be defined in writing by the Contractor whom shall then notify the Engineer in writing of a conflict for resolution prior to installation, fabrication, and/or construction.

3.3.14 Identification and Marking.

- a. A nameplate of phenolic, stainless steel, or other approved material shall identify each identifiable major equipment item. The nameplate shall be secured to the equipment item by stainless steel screws, stainless steel rivets, or by use of a suitable adhesive compatible with the equipment item's materials of construction.
- b. Name plates shall be embossed with the following information, as applicable:
 - Equipment item
 - Equipment item tag number
 - Size
 - Pressure rating
 - Temperature rating
- c. Instrumentation shall have phenolic or stainless steel tags permanently attached with stainless steel wire, screws, or rivets, or by use of a suitable adhesive compatible with the equipment item's materials of construction.
- d. Chemical transfer lines shall be color coded in accordance with 30 TAC Part 1 Chapter 290.42.

3.4 Fluoridation System Technical Requirements

- a. The fluoride chemical injection pump shall be wired electrically in series with a main well pump, service pump, or other approved plant control system such that it cannot operate unless water is being produced (interlocked).

- b. It shall be physically impossible to plug a fluoride-metering pump into any continuously active ("hot") electrical outlet. If the metering pump is not hardwired directly into the electrical circuit providing interlock protection to the well or service pump, then the metering pump shall be equipped with a **special**, clearly labeled plug (6-15P or 6-20P) that is compatible only with a special outlet (6-15R and/or 6-20R) on an appropriate circuit.
- c. Unless otherwise specified, a flow switch, pressure switch, or other approved flow-based secondary interlock device shall be provided as back-up protection in water systems serving less than 500 people. The device shall be electrically interlocked to the metering pump to provide secondary flow-based control.
- d. Fluoride injection should occur where all of the water to be treated water passes; however, fluoride should not be injected where substantial losses of fluoride can occur such as downstream of chlorine injection points.
- e. Fluoride injection into a water line should be located in the lower third of the pipe and the injection quill shall extend a minimum of one-third of the pipe's diameter into the pipe.
- f. A corporation stop valve with safety chain shall be used at the fluoride injection point when injected into a line under pressure.
- g. A drop out piping spool with isolation valves shall be provided at injection points in a pressured line to allow for the maintenance and inspection of anti-siphon devices and to remove fluoride injection quills.
- h. A minimum of two anti-siphon devices shall be installed on all fluoride metering pumps. One valve shall be located at the fluoride injection point and the other at the metering pump head on the discharge side or as a separate anti-siphon device in the discharge line immediately downstream of the chemical metering pump. Each anti-siphon device shall have a diaphragm that is spring-loaded in the closed position.
- i. The pump shall always be mounted above the day tank using only top penetration suction tubing. The fluoride chemical metering pump shall not be mounted more than 5 feet higher than the lowest normal liquid level in the day tank. **Flooded suction supply lines shall not be used to feed a fluoride chemical injection pump.**
- j. The metering pump should be sized to feed fluoride near the midpoint of its operating range. The pump should be sized to operate between 30% to 70% of capacity.
- k. The pump capacity should be limited to a maximum adjusted fluoride level of 2 mg/l when calculated for the annual average water production rate.
- l. Priming valves on fluoride metering pumps shall be spring-loaded.
- m. A spare pump does not have to be supplied or installed for each size of metering pump used to inject fluorosilicic acid.
- n. In line mixers or small mixing tanks shall be installed in the finished water line if the first customer is less than or equal to 100 feet from the fluoride injection point **and** if there is no storage tank located in the line before the water reaches the first customer.
- o. A master meter on the main water service line must be provided on systems adding fluoride.
- p. Fluoride feed lines shall be color coded, when practical, or clearly marked with tags or signage. Pipe that is color-coded shall be painted light blue with red bands in

- accordance with the Uniform Plumbing Code. The word "fluoride" and the direction of flow shall be painted on the pipe or affixed to the pipe with a label
- q. All hose connections within reach of fluoride feed equipment shall be provided with hose bib type vacuum breakers.
 - r. All fluorosilicic acid shall conform to AWWA standard B-703.
 - s. Fluorosilicic acid shall not be diluted prior to injection.
 - t. No more than a 7-day supply of fluorosilicic acid should be connected at any time to the suction side of a chemical metering pump. All bulk storage tanks with more than a 3-day supply shall have a day tank. A day tank should only contain a small amount of acid, usually a 1 to 3 day supply. The public water supply owner/operator shall seasonally adjust the volume of acid available in the day tank to be pumped to meet the 3-day limit criteria.
 - u. Day tanks shall be located on scales; daily weights shall be measured and recorded.
 - v. Day tanks and carboys/drums shall be completely sealed and vented to the outside. Note that the vent for fluorosilicic acid shall be located high since the vapors produced are lighter than air.
 - w. Bulk storage tanks and day tanks shall be provided with secondary containment.
 - x. Fluorosilicic acid piping or tubing on the discharge of the chemical metering pump shall have secondary containment, except at the connection to the injection point and at the chemical injection pump.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Tank tests and Inspections.

- a. The tank manufacturer shall hydrotest each tank used in the assembly of the double containment tank. The minimum holding time for the water test shall be 12 hours after the filling height is reached.
- b. The Contractor shall inspect tanks immediately upon delivery to the site. If damaged, then the Contractor shall notify the tank supplier, tank owner/grantee, and the Engineer at once. The bottom of the bulk storage tank shall be visually inspected 100% for any damage. All tank fittings shall be 100 % inspected for tightness and physical damage.
- c. Contractor shall not install damaged tanks until repairs are made in accordance with the tank manufacturer's instructions after approval of the repair procedure by the project engineer.
- d. Contractor shall hydrotest the installed tank using potable water filled to the top of the straight wall section of the inner tank. The minimum holding time for the water test shall be 12 hours after the filling height is reached. Leaks shall be repaired in accordance with approved repair procedures. The Contractor shall remove all hydrotest water from the tank after completion of the test.

4.2 Piping hydrotest.

- a. All piping and tubing operating at greater than atmospheric pressure shall be hydrotested prior to the introduction of fluorosilicic acid.

- b. Any leaks shall be repaired by the Contractor and re-tested prior to commissioning the system.

SPECIFICATION WP-242

PHOSPHATE SYSTEM

1.01 GENERAL:

The Contractor shall furnish all transportation, labor, materials, equipment and supervision required to furnish and install the proposed new phosphate equipment, piping, and appurtenances complete as shown on the plans and specified herein. Acceptable manufacturer is Wallace & Tiernan.

2.01 SCOPE:

The Contractor's work to be performed under this section shall include furnishing and installing the proposed phosphate system consisting of: (1) Day tank with 110% containment, Chemical metering pump system including (2) pumps, control panel and accessories, automatic vent fan control circuits and maintenance kit, and miscellaneous appurtenances as shown on the plans and as specified herein.

- A. Metering Pumps: Chemical metering pump system shall be a skid mounted system, Wallace & Tiernan E-Z2MB-M including (2) pumps, control panel and accessories as noted. System shall contain all pipes, valves and fittings recommend by the manufacture for a safe and reliable operating system. Pumps shall be of the positive displacement, non-hydraulic, solenoid-driven, diaphragm-type. Output shall be hot rated at operating temperature, and adjustable while pumps are in operation. Positive flow shall be ensured by a minimum of four ball type check valves and a 5 function valve for pressure relief, back pressure, anti-siphon, air bleed and discharge drain. The pump shall be a Wallace & Tiernan Premia 75 Series. Pump shall operate from 115 VAC, 50/60Hz, 1 pH / 230 VAC.

Pump	GPH	PSI
1 – Primary	5	150
2 – Back up5		150

- B. Control Panel: The control panel shall be located opposite the liquid end. Capacity adjustment shall be via dial knobs for stroke length and stroke frequency. Control functions shall be manual with start/stop based on well flow. A flow switch located in the well collection line shall provide for positive flow indication and control. Turndown ratio shall be 100:1. A non voltage contact closure to the stop function shall cause the pump to halt operation, in either manual or automatic mode, and illuminate a red indicator light on the pump control panel. Pump shall resume normal operation when contact opens. The electronic circuitry shall be EMI resistant and shall employ a metal oxide varistor for lightening protection.

- C. Accessories: Accessories per each pump unless noted
- a. (1) calibration column
 - b. 4 way valves providing BPV, PRV, prime and anti-siphon capability
 - c. Wall bracket
 - d. Suction wand

- D. Day tank and containment: Containment facilities for a single container must be large enough to hold the maximum amount of chemical that can be stored with a minimum freeboard of six vertical inches or to hold 110% of the total volume of the container, whichever is less. All chemical shall be NSF compliant with documentation of specific chemical provided. Secondary containment systems shall be used to contain uncontrolled releases of chemical during operations and maintenance activities. Personnel protection equipment such as gloves, jackets, goggles, and face shields, etc. shall be provided at all times for the safe handling of liquid phosphate.

3.01 MATERIALS:

All materials used in the plant shall be in accordance with the standards of the American Society for Testing and Materials, American Water Works Association, Texas Commission on Environmental Quality, and the American National Standard Institute as they may apply to the materials used in the construction of this facility. In all cases, the material of construction and the equipment to be installed shall be new and undamaged in shipment or installation.

4.01 WORKMANSHIP:

In all phases of the work only competent, certified, skilled mechanics shall be employed and the work shall be in accordance with the Standard and Specifications as set out herein.

5.01 REFERENCE STANDARDS:

All work and materials under this section shall conform to the requirements of the Texas State Department of Health, American Society for Testing and Materials, National Electrical Code, National Fire Protection Association, National Electrical Manufacturers Association, Underwriter's Laboratories, American National Standards Institute, Occupational Safety and Health Agency, The Chlorine Institute, Inc. and all local ordinances.

6.01 DRAWINGS:

- A. The Contractor shall review all pertinent drawings and adjust his work to the conditions shown thereon. Discrepancies between drawings, specifications, and actual field conditions shall be brought to the prompt attention of the Engineer.
- B. The drawings indicate the approximate locations of existing and proposed power outlets, feeders, branch circuits, panel boards, etc. The exact location of these items shall be determined by measurement in the field from building lines. Such locations will, at all times, be subject to the approval of the Engineer.

The Engineer reserves the right to make any reasonable change in the outlet locations indicated, without any additional cost to the Owner.

7.01 MANUFACTURER:

All phosphate equipment shall be furnished by a single manufacturer. The manufacturer's representative shall inspect the equipment after the installation is complete, make all necessary adjustments to the equipment, and provide 8 hours of continuing instruction to the operator in proper operation and maintenance. The phosphate equipment shall be manufactured by Wallace & Tiernan.

8.01 SUBMITTALS:

The Contractor shall submit, (5) five sets of drawings for review by the Engineer. The information shall include performance data, piping schematics, and detailed installation instructions and drawings.

9.01 SUBSTITUTION:

Bidders are cautioned to obtain approval of other than the Specified System. The Contractor shall submit written modification outlining in detail the substitutions proposed to the Engineer seven work days prior to bid. The contractor shall state advantages, including price allowance and operational advantages for substitutions. An addendum will be issued if acceptable. If use of substitution requires changes or modifications in plans, the Contractor will reimburse the Engineer for cost of such changes.

10.01 UNIT RESPONSIBILITY:

Substitutions accepted by the Engineer shall not relieve the Contractor of the responsibility of furnishing an operational system and if a substitute system fails to perform as required, and is judged faulty, solely at the discretion of the Engineer, the Contractor will be required to remove the substitute system and to install the originally specified system at no additional cost to the Owner.

11.01 OPERATION AND MAINTENANCE INSTRUCTIONS:

The Contractor shall furnish four (4) copies of instruction books, diagrams (including shop drawings), and parts lists with manufacturer's identifying symbols covering all items of equipment furnished. Each of the appropriate publications and drawings shall be placed in binders with each item properly indexed and delivered to the Engineer before final acceptance of work.

12.01 TESTING AND START-UP:

The chlorination system equipment shall be tested prior to being placed in operation. The Contractor shall provide the services of a competent engineer or technician for a minimum of 8 hours for initial start-up and checking out of the equipment installation and its operation. In addition, the manufacturer's representative shall visit the installation at least once during each three month period for a period of one (1) year

after start-up to check on and report to the Owner the condition of the equipment and make any adjustments necessary at no extra cost to the Owner.

13.01 GUARANTEE:

All materials, equipment, and appurtenances shall be guaranteed against defects in material and workmanship for a period one (1) year from the date of acceptance by the Owner.

14.01 MEASUREMENT AND PAYMENT:

The various items and work described herein shall not be measured. Payment for items and work described herein shall be made under the Lump Sum Price Bid, for "PHOSPHATE SYSTEM", and shall include all labor, supervision, equipment, materials, and incidental items necessary to complete the work as shown on the plans and described in these specifications.

END OF SECTION

SECTION 520

WATER PLANT PIPING

1.0 SCOPE

This section includes furnishing and installing steel and ductile iron pipe and fittings for the construction of water lines within the water plant fence.

2.0 PRODUCTS

Unless otherwise noted on the drawings all water piping within the plant boundaries shall be ductile iron pipe.

a. **Ductile Iron Pipes.**

Ductile iron pipe and fittings shall be manufactured in accordance with AWWA C110. Pipe thickness shall be Class 53 for above ground service and Class 51 for buried service. Flanged joints shall be used for the suction and discharge header, all above ground piping and also for the first horizontal joint after a piping section has gone below grade.

- (1) Interior Coating - Coat the inside of the pipe with cement mortar in accordance with the latest revision of AWWA C-104.
- (2) Exterior Coating - Coat the outside of the pipe with coal tar enamel or asphalt base bituminous material. Do not coat exterior of pipe to be installed above ground. All underground flanged joints to be coated and poly-wrapped.

b. **Steel Pipe.**

Steel pipe and fittings shall be used where indicated on the drawings and in accordance with AWWA C200, C206, and C207. The minimum pipe wall thickness shall be:

- (1) Less than 5 inches: schedule 40
- (2) 6 to 10 inches: 3/16 inch
- (3) 12 to 14 inches: 7/32 inch
- (4) 16 to 42 inches: 1/4 inch

Coatings shall consist of the following:

- (1) Interior Coating - Coat the inside of the pipe with polyamide epoxy that meets NSF 61 Standards.
- (2) Exterior Coating - Coat the above ground steel pipe as specified in WP-225. Below ground steel pipe shall be coated with coal tar and wrapped with polyethylene encasement, or hot applied coal tar tape coating, or cold applied tape coating system.

c. **Valves.**

- (1) Gate valves shall be cast iron or ductile iron body, double disk or resilient

- seat and O-ring seal. Gate valves must conform to the latest revision of AWWA C-500 to C-509. Furnish a non-rising valve stem, which turns counterclockwise to open, and a valve box for underground installation.
- (2) Butterfly valves shall conform to the latest revision of AWWA C-504. Furnish valve operators, which turn counterclockwise to open.
 - (3) Check valves for booster pumps shall be slanting disc check valves APCO series 800 or equal. Check valves for well manifolds shall be APCO series 600 globe style silent check valves.
 - (4) Air and Vacuum Release Valve Assembly for well manifold shall be 3 inch for wells less than 1,500 gpm and 4 inch for wells over 1,500 gpm. The surge check unit shall be APCO No. 704, the air and vacuum valve shall be APCO No. 152 and the air release valve shall be APCO No. 200A.

3.0 HANDLING

Pipe, fittings, and accessories shall be handled in a manner that will insure their installation in sound, undamaged condition. Equipment, tools and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that they are not damaged. Hooks inserted in ends of pipe shall have broad, well padded contact surfaces. All pipe coating which has been damaged shall be repaired by the contractor before installing the pipe.

4.0 CUTTING PIPE

Cutting pipe shall be done in a neat manner, without damage to the pipe or to the cement lining therein. Pipe cuts shall be smooth straight, and at right angles to the pipe axis. All cutting of pipe shall be done with mechanical pipe cutters of an approved type.

5.0 CLEANING

The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter before being installed and shall be kept clean until the work has been accepted. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. No debris, tools, clothing, or other material shall be placed in the pipe.

6.0 INSPECTION

Before installation, each pipe and fitting shall be inspected for defects and rung with a light hammer to detect cracks. All defective, damaged, or unsound pipe and fittings shall be rejected and removed from the site of the work.

7.0 LAYING PIPE

Under no circumstances shall pipe, to be placed below grade, be laid in water and no pipe shall be laid under unsuitable weather or trench conditions. Pipe for the water distribution line shall be laid with the center line at a minimum depth of 4 feet below

grade.

8.0 FLANGED JOINTS

When bolting flanged joints, care shall be taken to insure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate, in such a manner that gasket compression is uniform over the entire area of the gasket.

- a. Special care shall be taken when attaching suction and discharge piping to pumping equipment to insure that no stresses are transmitted to or imposed on the pump suction and discharge flanges by the connected piping. All such piping shall be installed and supported so that accurate matching on bolt holes and uniform contact over the entire area of abutting pump and connecting piping flanges are obtained before installation of any bolts in those flanges. In addition, the pump connection shall be free to move parallel to its longitudinal center line while the bolts in the pump connection flanges are tightened.
- b. To provide maximum flexibility and ease of alignment correction by taking advantage of the stack between flange bolts and bolt holes for slight angular rotation of connecting flanges, the pump connecting piping shall be assembled, with gaskets in place, with only a portion of the flange bolts (not less than 4 per joint) installed. After final alignment and before final bolting, the pump connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints.
- c. All underground pipe joints shall be used push-on B & S Bell-Tile or non-threading or bolted joint, no flanged or M.J. joints used for underground piping.

9.0 ANCHORAGE OF FITTINGS

All tees, elbows, and plugs below grade shall be anchored by concrete thrust blocks as per details shown on the plans. Blocks shall be so placed that the joints will be accessible for inspection and repair. Concrete shall be 3000 psi (Class A). Supports for above grade piping shall be provided as shown on the drawings.

10.0 LEAKAGE

It is the intent of this specification that:

- a. All joints shall be watertight and free from visible leaks.
- b. Each leak which may be discovered, at any time prior to the expiration of one year after the date of final acceptance of the work by the Owner, shall be repaired by and at the expense of the Contractor.

11.0 DISINFECTION & TESTING

All pipe, fittings, valves, and equipment shall be disinfected and pressure tested in accordance with Specification No. 275.

END OF SECTION

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 paramount 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 City of Tomball Water Plant No. 3, and Standby Generator Set

- a. Install New Electrical Service, with Lightning Protection and Phase Failure Detection
- b. Site Grounding System
- c. Install New Telephone Service
- d. New Motor Control Center(s), with wall-mounted single phase transformer and panelboard.
- e. Assemble and Install New Plant Control Panel and Interconnect Wiring
- f. Assemble and Install New Auto Dialer Panel, and Interconnect Wiring.
- g. New 120/240V Feeders to Panels and Equipment
- h. Underground Duct Banks
- i. Motor and Equipment Feeders
- j. Electrical Panel and Equipment Identification
- k. Interior Lighting (Control Room and Chlorine Room)
- l. Control Room Loads
- m. Chlorine Room Loads (Chlorine Detection, Room Heater, Vent Fans, etc.)
- n. Exterior Lighting (Well Pumps and Booster Pump Pad)
- o. Hydro Level Probe(s)
- p. Pressure Tap tubing from G.S.T.(s) and Hydro(s) to Control Panel Instruments
- q. Field Instrumentation at Well Pumps (High Pressure and No-Flow)

- r. Install Standby Generator Set, Automatic Transfer Switch, and auxiliary load feeders (battery charger, strip heater, and block heater); auto-start signal, alarm signals, and service conduits.

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.

SECTION 16012
ELECTRICAL WORK

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.

The following manufactures are acceptable:

1. Weimar Manufacturing
2. Square D
3. Siemens
4. General Electric
5. Cutler Hammer

6. Systems
7. B.L. Technology
8. or, Pre-Approved equal

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 manufacturers 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.

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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 malleable iron or ferrous 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.

SECTION 16111
CONDUIT, FITTINGS 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.

SECTION 16111
CONDUIT, FITTINGS AND BODIES

- 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 be 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.

SECTION 16111
CONDUIT, FITTINGS AND BODIES

- 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" conduit equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.
- 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.

SECTION 16111
CONDUIT, FITTINGS AND BODIES

- 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.

SECTION 16111
CONDUIT, FITTINGS AND BODIES

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.

SECTION 16120
600-VOLT BUILDING WIRING AND CABLE

d. Wire Marking

1. Wire marking shall be in accordance with NEC Article 310-11 and shall be printed on the wire insulation at 2-foot intervals.
2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color.

e. The single conductor color coding shall be as follows:

<u>System Voltage</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Neutral</u>
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue.....	White
120/240 Volt 3Ph/4w	Black	Orange.....	Blue.....	White
277/480 Volt 3Ph/4w	Brown.....	Purple.....	Yellow.....	Grey
Motor Control	1	Black		
	2	Red		
	3	Blue		
Ground			 Green

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

SECTION 16120
600-VOLT BUILDING WIRING AND CABLE

2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring where conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels.
 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.

SECTION 16120
600-VOLT BUILDING WIRING AND CABLE

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.

SECTION 16131
DEVICE, PULL AND JUNCTION BOXES

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 ferrous 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:

SECTION 16135
CABINETS, BOXES, AND FITTINGS

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. Description of Work:

1. Motors furnished under other sections of these Specifications as part of equipment items shall conform to requirements of this section except as noted otherwise in that section or indicated otherwise on Drawings or schedules.

1.2 REFERENCES

a. National Electrical Manufacturers Association (NEMA):

1. NEMA MG 1-1978 - Motors and Generators.

b. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE Standard 112-1978 - Standard Test Procedure for Polyphase Induction Motors and Generators.

c. Anti-Friction Bearing Manufacturers Association (AFBMA):

1. AFBMA Standards for Ball and Roller Bearings and Balls.

d. National Electrical Contractors Association (NECA):

1. Standard of Installation.

1.3 SUBMITTALS

a. Submit all products covered under this specification for Engineer's approval.

b. Include motor submittal as part of equipment submittal for equipment specified in other sections.

c. Include identification of equipment by name and tag number as indicated in Specifications or on Drawings.

- d. Submit in accordance with General Conditions and other applicable sections of the Contract Documents.
 - 1. Complete nameplate data in accordance with NEMA standards.
 - 2. Full load power factor and maximum correction capacitor kVA for motors 5 hp and larger.
 - 3. Nominal efficiency in accordance with IEEE 112 for motors 5 hp and larger.
 - 4. Motor dimensions and frame size.
 - 5. Manufacturer's printed data on each motor type being provided to indicate compliance with specified performance and construction.
 - 6. Service manual to include storage and alignment instructions.
- e. Operation and Maintenance (O&M) Data:
 - 1. Submit in accordance with General Conditions and other applicable sections of the Contract Documents.

1.4 QUALITY ASSURANCE

- a. Source Quality Control:
 - 1. Perform individual motor test on motors over 1 hp.
 - 2. Test shall be standard NEMA routine production test in accordance with MG 1-12.51, and consisting of following.
 - (a) No load running current.
 - (b) Locked rotor current.
 - (c) High potential test.
 - (d) Bearing inspection.
- b. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA):
 - (a) NFPA No. 70 - National Electrical Code (NEC).
 - 2. Underwriters Laboratories, Inc. (UL).

3. Local codes and ordinances.

2.0 PRODUCTS

2.1 GENERAL

- a. Use of manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired.
- b. Unless otherwise specified, meet or exceed following.
 1. High efficiency, equivalent to U.S. Motors premium efficiency for motors 5 hp and above.
 2. Motors 1/2 hp and Larger: 3-ph, 60 Hz, 230/460 V.
 - (a) Squirrel cage type, NEMA B.
 - (b) Motor Housing and Bearing Brackets: Cast grey iron with tensile strength of 30,000 psi. Do not provide rolled steel and aluminum.
 - (c) Secure bearing brackets to motor cast iron housing. Do not use bolt clamping methods.
 - (d) Provide dual voltage windings, 230/460 V.
 3. Motors Less than 1/2 hp: 1-ph, 60 Hz, 115/230 V.
 - (a) Provide dual voltage windings, 115/230 V.
 4. Suitable for continuous operation with line voltage variation within $\pm 10\%$ of rated voltage.
 5. Suitable for continuous operation in 40°C ambient with 80°C temperature rise..
 6. Copper motor windings.
- c. Design for frequent starting.
- d. Provide internal, 120 Vac, heaters sized per manufacturer's recommendations based on use and location.
- e. Where used in conjunction with electronic variable speed drive units such as VFD's, coordinate with drive equipment manufacturer to provide a matched motor and drive system. Failure to do so

will result in any additional charges to be paid by contractor and at no additional cost to Owner.

2.2 MANUFACTURERS

- a. U.S. Motors
- b. Marathon
- c. Or equal as approved by Engineer.

2.3 ENCLOSURES

- a. Open Dripproof (ODP): Indoor areas where clean, dry, and well ventilated.
- b. Weather Protected I (WPI): Indoor or outdoor areas where exposed to moisture or dirt.

2.4 INSULATION

- a. Dripproof Motors: Class F, 1.15 service factor.
 - 1. Two extra dips and bakes of epoxy varnish.
- b. Weather Protected I: Class F, 1.15 service factor.
 - 1. Two extra dips and bakes of epoxy varnish.

2.5 BEARINGS

- a. Ball or roller bearing type at manufacturer's option, unless specified in equipment sections of Specifications.
- b. Support side thrust loadings.
- c. Regreaseable with alomite fittings extended to accessible location for Frame 250 and larger.
- d. AFBMA B10 bearing life rated (flexible coupled) at 50,000 hrs.

2.6 SPEED

- a. As specified under equipment section.

2.7 TORQUE

- a. Breakdown torque shall be 200% or more of maximum torque load placed on motor shaft.
- b. Provide necessary WK₂ curves for special loads to coordinate with motors.
- c. Supply special motors where load requirements exceed standard design.

2.8 SLIDE RAILS AND SOLE PLATE

- a. As required for application.

2.9 SINGLE PHASE FRACTIONAL HP MOTORS

- a. Capacitor or open split phase start, unless otherwise specified.

2.10 THREE PHASE MOTORS

- a. Provide horizontal or vertical squirrel cage induction motors for standard duty.
- b. Full voltage starting or as specified in equipment sections of Specifications or on Drawings.

3.0 EXECUTION

3.1 GENERAL

- a. Install in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA "Standard of Installation," and recognized industry practices.

3.2 ALIGNMENT

- a. Contractor furnishing motor shall be responsible for alignment.
- b. Check alignment of motors prior to startup.
- c. Motors over 50 hp shall have alignment and balance checked using test equipment specially designed for this purpose.

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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.

SECTION 16195
ELECTRICAL IDENTIFICATION

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.

SECTION 16195
ELECTRICAL IDENTIFICATION

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.

SECTION 16195
ELECTRICAL IDENTIFICATION

- (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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PART 1 - GENERAL

1.1 SUMMARY OF PROJECT SPECIFIC REQUIREMENTS

- A. This Section includes packaged engine generator sets with the following features and accessories.
1. Client: City of Tomball, Water Plant No. 3
 2. Application: Standby Power
 3. Operation: Automatic Transfer - 1600A/3P, NEMA 1, Indoor
 4. Location: Vicinity of Houston, TX
 5. Rating: 750 kW @ 0.8 Power Factor
 6. Voltage: 480Y/277, 3 phase, 60Hz
 7. Overcurrent Protection: 1200A, 80% Rating, Molded Case, with Ground Fault Indication
 8. Voltage Dip: 20% maximum
 9. Frequency Dip: 10% maximum
 10. Maximum Alternator Temperature Rise: 125 deg. C
 11. Fuel: Diesel
 12. Fuel Tank: Sub-base, UL-142 Double Wall
 - a. 24 hour capacity tank @ 100% Load.
 13. Silencer: Critical
 14. Enclosure: Weatherproof, Sound Attenuating (84db @ 3ft) -Ref. Spec No. 16622
 15. Auxiliary Loads:
 - a. Engine Block Heater(s)
 - b. Alternator Strip Heater
 - c. Battery Charger
 - d. Control Panel Strip Heater
 16. Additional Accessories/Features
 - a. Gen Set Main Breaker auxiliary contact, wired into a control panel input, activating the Common Alarm Output when the main breaker is in the "OFF" position or "TRIPPED" position. (i.e. Alarm when not "ON")
 - b. Control Panel Space Heater, with Thermostat
 - c. Enclosure Electrical Package, consisting of:
 - 1) One (1) 15kVA Mini Power Zone, 480-120/240V, Single Phase, 60A Main Breaker, 80A Secondary Breaker, NEMA 3R Enclosure
 - 2) Four (4) Enclosure Lighting Fixtures (Fluorescent), located over the engine, and controlled by two (2) three-way light switches
 - 3) Two (2) 20A GFCI duplex Receptacles
 - 4) One (1) Ventilation Fan, located over the engine, with Thermostat (100-160 deg. F)
 17. Generator Sizing and Load Sequence Assumptions: Reference Section 3.6.

- B. See Division 16, Section 16496, "Automatic Transfer Switches" for transfer switches, containing sensors and relays to initiate automatic starting and stopping.

1.2 SUBMITTALS

- A. Provide (6) copies of the following submittal documents:
 - B. Product Data: For the generator set and each accessory component indicated.
 - C. Shop Drawings: Include plans, elevations, sections, details of installation, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - D. Certified prototype test reports.
 - E. Field quality-control test reports.
 - F. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of emergency maintenance and repairs at the Project with eight hours' maximum response time.
- B. Source Limitations: Obtain packaged engine generator and auxiliary components specified in this Section through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Comply with NFPA 110 requirements for Level 1 or 2 emergency power supply system, dependent on application.
- F. Noise Emission: Comply with all applicable federal, state, and local government requirements for maximum noise level at adjacent property boundaries, due to sound emitted by generator set including engine, engine exhaust, engine cooling air intake and discharge, and other components of the installation.
- G. Air Emissions: Comply with all applicable federal, state, and local government requirements for maximum levels of air emissions.

- H. **Guarantee:** All systems and components supplied under this specification shall be guaranteed against defective materials, poor workmanship, design deficiencies, and failures, during the normal usage for a minimum of 12 months after date of commissioning. Vendor shall make necessary corrections to all deficiencies noted with this time, without expense to purchaser. Satisfactory warranty documents must be provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Spectrum Detroit Diesel.
 2. Cummins Power Generation/Onan
 3. Pre-approved equal

2.2 ENGINE GENERATOR SET

- A. Provide a coordinated assembly of compatible components.
- B. **Safety Standard:** Comply with ASME B15.1.
- C. **Nameplates:** Each major system component is equipped with a conspicuous nameplate of component manufacturer. Nameplate identifies manufacturer of origin and address, and model and serial number of item.

2.3 GENERATOR-SET PERFORMANCE

- A. **Steady-State Voltage Operational Bandwidth:** 4 percent of rated output voltage from no load to full load.
- B. **Steady-State Voltage Modulation Frequency:** Less than 1 Hz.
- C. **Transient Voltage Performance:** Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage recovers to remain within the steady-state operating band within three seconds.

- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When system is operating at any constant load within rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- F. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within five seconds.
- G. Output Waveform: At no load, harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
- H. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the generator and its protective devices will supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.
- I. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.4 SERVICE CONDITIONS

- A. Environmental Conditions: Engine generator shall be equipped to start and operate satisfactorily under the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C. (5 to 104 deg F)
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet (300 m).

2.5 ENGINE

- A. Description: 4-cycle unit with maximum piston speed of 2250 fpm (11.4 m/s)
- B. Comply with NFPA 37.
- C. Fuel: As specified in section 1.1.A. of this specification.
- D. Rated Engine Speed: 1800 rpm.
- E. Engine Brake Mean Effective Pressure (BMEP)

1. The engine BMEP shall be within the ranges stated below:
 - a. Gaseous (Industrial): 160 – 230 psi
 - b. Diesel (Truck): 150 - 250 psi
 - c. Diesel (Industrial): 250 – 350 psi

- F. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.

- G. Engine Fuel System: Comply with NFPA 37. System includes the following:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief/Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

- H. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment.

2.6 GOVERNOR

- A. Type: Adjustable isochronous, with speed sensing, or mechanical, dependent on gen-set size and required performance.

2.7 ENGINE COOLING SYSTEM

- A. Description: Closed loop, liquid cooled, with radiator factory mounted on engine generator-set skid and integral engine-driven coolant pump.
 1. Radiator Core Tubes: Nonferrous-metal construction other than aluminum.

2.8 FUEL SUPPLY SYSTEM

- A. Comply with NFPA 30 and NFPA 37.

- B. Day Tank: Comply with UL 142; listed, freestanding, factory-fabricated assembly of a fuel tank with integral, float-controlled transfer pump and the following features:
 1. Containment: Integral rupture basin, 150 percent of nominal capacity of day tank.
 2. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
 3. Tank Capacity: Adequate to supply fuel to engine for an uninterrupted period of operation, as specified in section 1.1.A. of this specification, at 100 percent of

- rated power output of engine generator system without being refilled (4 hour minimum).
 - 4. **Pump Capacity:** Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
 - 5. **Low-Level Alarm Sensor:** Operates alarm contacts at 75 percent of normal fuel level.
 - 6. **High-Level Alarm Sensor:** Separate device operates alarm and redundant fuel shutoff contacts at 106 percent of normal fuel level.
 - 7. **Piping Connections:** Include fuel suction and return lines to fuel storage tank; fuel supply; and return lines to engine, local fuel fill, vent line, overflow line, and tank drain line complete with shutoff valve.
- C. **Base-Mounted Fuel Oil Tank:** Factory-installed and -piped, listed unit. Features include the following:
- 1. Tank level indicator.
 - 2. **Capacity:** Fuel for continuous operation at 100 percent rated power output, for duration as specified in section 1.1.A of this specification.
 - 3. Vandal-resistant fill cap.
 - 4. **Containment Provisions:** Comply with requirements of authorities having jurisdiction.

2.9 ENGINE EXHAUST SYSTEM

- A. **Muffler:** Critical type, sized as recommended by engine manufacturer. Measured sound level at a distance of 10 feet (3 m) from exhaust discharge, is 85 dBA or less.
- B. **Muffler:** Residential type, sized as recommended by engine manufacturer. Measured sound level at a distance of 10 feet (3 m) from exhaust discharge, is 95 dBA or less.
- C. **Muffler:** Industrial type, sized as recommended by engine manufacturer. Measured sound level in the 20- to 75-Hz frequency band at a distance of 25 feet (8 m) from exhaust discharge, is 87 dBA or less.
- D. **Condensate Drain for Muffler:** Schedule 40, black steel pipe connected to muffler drain outlet through a petcock.
- E. **Connections from Engine to Exhaust System:** Flexible section of corrugated stainless-steel pipe.
- F. **Connection from Exhaust Pipe to Muffler:** Stainless-steel expansion joint with liners.
- G. **Supports for Muffler and Exhaust Piping:** Spring hangers and all-thread rods and vibration hangers.

- H. Exhaust Piping External to Engine: ASTM A 53, Schedule 40, welded, black steel, with welded joints and fittings.

2.10 COMBUSTION-AIR-INTAKE

- A. Description: Heavy-duty, engine-mounted air cleaner with replaceable dry filter element and "blocked filter" indicator.

2.11 STARTING SYSTEM

- A. Description: 12 or 24-V electric, dependent on engine requirements, with negative ground and including the following items:
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by generator-set manufacturer for cable length and battery capacity indicated. Include interconnecting conductors and connection accessories.
 6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit complies with UL 1236 and includes the following features:
 - a. Operation: Equalizing-charging rate of 10 A is initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit then automatically switches to a lower float-charging mode and continues operating in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjusts float and equalizes voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Ammeter indicates charging rate.

- e. **Safety Functions:** Include sensing of abnormally low battery voltage, arranged to close contacts providing low battery voltage indication on control and monitoring panel. Also include sensing of high battery voltage and loss of ac input or dc output of battery charger. Either of latter conditions closes contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. **Enclosure and Mounting:** NEMA 250, Type 1, wall-mounted cabinet.

2.12 CONTROL AND MONITORING

- A. **Functional Description – Automatic Operation:** When the mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic-transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set, if applicable.
- B. **Functional Description – Manual Operation:** Switching on-off switch on the generator control panel to the on position starts the generator set. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set, if applicable.
- C. **Configuration:** Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Mounting method isolates the control panel from generator-set vibration.
- D. **Indicating and Protective Devices and Controls:** Include those required by NFPA 110 for a Level 1 system, and the following:
- E. **Indicating and Protective Devices and Controls:** Include those required by NFPA 110 for a Level 2 system, and the following:
- F. **Indicating and Protective Devices and Controls:** Include the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.

6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator voltage adjusting rheostat.
 10. Start-stop switch.
 11. Overspeed shutdown device.
 12. Coolant high-temperature shutdown device.
 13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Low battery alarm.
 18. Battery charger malfunction alarm.
- G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.
- H. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated.
- I. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Locate audible device and silencing means where indicated. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
 2. Lube-oil low-pressure shutdown.
 3. Overspeed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high-temperature prealarm.
 6. Lube-oil low-pressure prealarm.
 7. Fuel tank low level.
 8. Overcrank shutdown.
 9. Coolant low-temperature alarm.
 10. Control switch not in auto position.
 11. Battery-charger malfunction alarm.
 12. Battery low-voltage alarm.
- J. Remote Emergency-Stop Switch: Flush wall-mounted, unless otherwise indicated and prominently labeled. Push button is protected from accidental operation.

2.13 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; rated as specified in section 1.1.A. of this specification; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator rating.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Circuit Breaker: Molded-case, electronic-trip type; rated as specified in section 1.1.A. of this specification; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 2. Trip Settings: Matched to generator thermal damage curve as closely as possible.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Generator Disconnect Switch: Molded-case type, rated as specified in section 1.1.A. of this specification.
1. Rating: Matched to generator output rating.
 2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
- D. Generator Protector: Microprocessor-based unit that continuously monitors current level in each phase of generator output, integrates generator heating effect over time, and predicts when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector performs the following functions:
1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As heating effect on the generator of overcurrent approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect switch, and shuts down the generator set.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.14 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1 and specified performance requirements.
- B. Drive: Generator shaft is directly connected to engine shaft. Exciter is rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during specified intervals of operation at 110 percent of rated capacity.
- F. Exciter uses no slip or collector rings, or brushes, and is arranged to sustain generator output under short-circuit conditions as specified.
- G. Enclosure: Dripproof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel provides plus or minus 5 percent adjustment of output- voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.15 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple housing-access panels are lockable and provide adequate access to components requiring maintenance. Panels are removable by one person without tools. Instruments and controls are mounted within enclosure.
- B. Engine Cooling Airflow through Enclosure: Adequate to maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in "Service Conditions" (Reference Section 2.4).
- C. Louvers: Fixed-engine cooling air inlet and discharge. Louvers prevent entry of rain and snow.
- D. Convenience Outlet: Factory wired. Arrange for external circuit supply.

2.16 FINISHES

- A. Description: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.17 SOURCE QUALITY CONTROL

- A. Factory Tests: Include prototype testing and Project-specific equipment testing (testing of equipment manufactured specifically for this Project).
- B. Prototype Testing: Performed on a separate engine generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with those required for Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110.
- C. Project-Specific Equipment Tests: Factory test engine generator set and other system components and accessories before shipment. Perform tests at rated load and power factor. Include the following tests:
 - 1. Full load run.
 - 2. Maximum power.
 - 3. Voltage regulation.
 - 4. Transient and steady-state governing.
 - 5. Single-step load pickup.
 - 6. Safety shutdown.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine generator manufacturers' written installation and alignment instructions, and with NFPA 110.
- B. Set packaged engine generator on concrete base. Cast-in-place concrete, reinforcement, and formwork as specified the foundation specifications.
 - 1. Support generator-set mounting feet on rectangular metal blocks and shims or on metal wedges having small taper, at points near foundation bolts to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until generator is level.

- C. Install packaged engine generator to provide access for periodic maintenance without removing connections or accessories.
- D. Install exhaust-system piping for diesel engines. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
- E. Install condensate drain piping for diesel-engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.2 IDENTIFICATION

- A. Identify system components according to Division 15 Section "Mechanical Identification" and Division 16 Section "Electrical Identification."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to supervise testing. Report results in writing.
- B. Tests: Include the following:
 - 1. Tests recommended by manufacturer.
 - 2. InterNational Electrical Testing Association Tests: Perform each visual and mechanical inspection and electrical and mechanical test stated in NETA ATS for emergency engine generator sets, except omit vibration baseline test. Certify compliance with test parameters for tests performed.
 - 3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
 - a. Single-step full-load pickup test.
 - 4. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.
 - 5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator installation before and during system operation. Check for air, exhaust, and fluid leaks.
 7. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 8. Noise Level Tests: Measure A-weighted level of noise emanating from the generator-set installation, including engine exhaust and cooling air intake and discharge, at four locations on the property lines, and compare measured levels with required values.
- C. Coordinate generator-set tests with tests for transfer switches and perform them concurrently.
 - D. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
 - E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations.
 - F. Test instruments shall have been calibrated within the last 12 months, traceable to NIST standards, and adequate for making positive observation of test results. Make calibration records available for examination on request.

3.4 BATTERY EQUALIZATION

- A. Description: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.
 1. Coordinate with training requirements for transfer switch.

3.6 GENERATOR SIZING AND LOAD SEQUENCE ASSUMPTIONS

- A. Reference the document immediately following this specification, for load sequencing and generator sizing assumptions.

- B. Prior to purchasing the generator set, the contractor shall verify the code letters for all motors provided, and shall compare to the design values, as shown in the following document. Any discrepancies shall be immediately reported to the responsible project engineer for generator set sizing adjustments, as required.

END OF SECTION 16231

COBB FENDLEY & ASSOCIATES
 TOMBALL WATER PLANT #3



Recommended Generator Report - 750DFGE
 for Project Cbc08009_All Loads

Project Parameters			
Generator Sets Running in Parallel:	1	Fuel:	Diesel
Max Allowable Starting Voltage Dip:	20 %	Phase:	3
Max Allowable Peak Voltage Dip:	20 %	Frequency, Hz:	60
Max Allowable Frequency Dip:	10 %	Voltage:	277/480, Series Wye
Site Altitude, Ft. (M):	300 (91)	Quiet Site:	No
Site Ambient Temperature, °F (°C):	104 (40)	Duty:	Standby

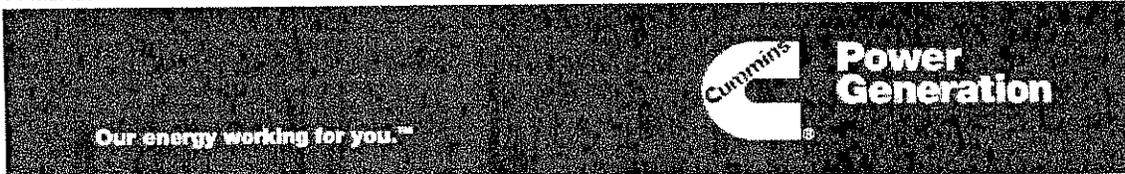
Calculated Individual Generator Set Load Running and Peak Requirements						
Running kW:	645.9	Max Step kW:	277.5	In Step 9	Cumulative Step kW:	642.6
Running kVA:	706.8	Max Step kVA:	1321.6	In Step 9	Cumulative Step kVA:	1723.2
Running PF:	0.91	Peak kW:	None		Cumulative Peak kW:	None
Alternator kW:	645.9	Peak kVA:	None		Cumulative Peak kVA:	None

Generator Set Configuration			
Engine Model:	VTA28-G7	Alternator:	HC6G
Fuel:	Diesel	Feature Code:	B246
Engine Displacement, cu in (liters):	1710 (28)	Reconnectable	
Engine Cylinders:	12		
Excitation:	PMG	Voltage Range:	LimR 480
Temp. Rise at Full Rated Load, °C:	125 ²	Number Leads:	12

<u>Set Performance</u>		<u>Load Requirements</u>	
Running at:	86.1% Rated Capacity	Max Starting Voltage Dip:	20 %
Starting Voltage Dip:	20 %	Max Peak Voltage Dip:	20 %
Peak Voltage Dip:	None %	Max Frequency Dip:	10 %
Frequency Dip:	3 %	Running kW:	645.9
Site Rated kW:	750	Alternator kW:	645.9
Site Rated Alternator Max kW at 125°C and 480 volts:	800	Running kVA:	706.8
Site Rated Alternator Max kVA at 125°C and 480 volts:	1000	Effective Step kW:	540.5
Site Rated Max SKW:	770	Effective Step kVA:	1653.4
Max SKVA:	2944		

²Note: Higher temperature rise at full rated load.

COBB FENDLEY & ASSOCIATES
TOMBALL WATER PLANT #3



Loads and Steps Detail Report
for Project Cbc08009_All Loads

Project Parameters

Generator Sets Running in Parallel:	1	Fuel:	Diesel
Max Allowable Starting Voltage Dip:	20 %	Phase:	3
Max Allowable Peak Voltage Dip:	20 %	Frequency, Hz:	60
Max Allowable Frequency Dip:	10 %	Voltage:	277/480, Series Wye
Site Altitude, Ft. (M):	300 (91)	Quiet Site:	No
Site Ambient Temperature, °F (°C):	104 (40)	Duty:	Standby

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW:	645.9	Max Step kW:	277.5	In Step 9	Cumulative Step kW:	642.6
Running kVA:	706.8	Max Step kVA:	1321.6	In Step 9	Cumulative Step kVA:	1723.2
Running PF:	0.91	Peak kW:	None		Cumulative Peak kW:	None
Alternator kW:	645.9	Peak kVA:	None		Cumulative Peak kVA:	None

Step 1

Calculated Individual Generator Set Step Load Requirements

Running kW:	30.0	Starting kW:	30.0	Cumulative Step kW:	30.0
Running kVA:	30.0	Starting kVA:	30.0	Cumulative Step kVA:	30.0
Running Amps:	36.1				
Alternator kW:	30.0				

15kVA Xfmr		Single Phase	Quantity: 2 In this Step		
Category:	Miscellaneous - User Defined				
Running kW:	15.0	Starting kW:	15.0	Peak kW:	None
Running kVA:	15.0	Starting kVA:	15.0	Peak kVA:	None
Running PF:	1.00	Starting PF:	1.00	Cyclic:	No
Running Amps:	31.3				
Alternator kW:	15.0			Voltage:	480

Step 2

Calculated Individual Generator Set Step Load Requirements

Running kW:	4.4	Starting kW:	22.9	Cumulative Step kW:	52.9
Running kVA:	5.2	Starting kVA:	37.5	Cumulative Step kVA:	67.5
Running Amps:	6.3				
Alternator kW:	4.4				

5hp Air Compressor		Three Phase	Quantity: 1 In this Step		
Category:	Motor				
Running kW:	4.4	Starting kW:	22.9	Peak kW:	None
Running kVA:	5.2	Starting kVA:	37.5	Peak kVA:	None
Running PF:	0.85	Starting PF:	0.61	Cyclic:	No
Running Amps:	6.3				
Alternator kW:	4.4			Voltage:	480

Shaft HP:	5.00	Method:	Across The Line
Shaft kW:	3.73		
Efficiency:	0.84	LRkVA Factor:	7.5
Design:	Standard NEMA Design B, C, or D	LRkVA Code:	J

Step 3

Calculated Individual Generator Set Step Load Requirements

Running kW:	49.7	Starting kW:	127.4	Cumulative Step kW:	161.9
Running kVA:	55.3	Starting kVA:	354.0	Cumulative Step kVA:	389.2
Running Amps:	66.6				
Alternator kW:	49.7				

60hp Booster Pump Three Phase Quantity: 1 In this Step

Category:	Motor				
Running kW:	49.7	Starting kW:	127.4	Peak kW:	None
Running kVA:	55.3	Starting kVA:	354.0	Peak kVA:	None
Running PF:	0.90	Starting PF:	0.36	Cyclic:	No
Running Amps:	66.6				
Alternator kW:	49.7			Voltage:	480

Shaft HP:	60.00	Method:	Across The Line
Shaft kW:	44.76		
Efficiency:	0.9	LRkVA Factor:	5.9
Design:	Standard NEMA Design B, C, or D	LRkVA Code:	G

Step 4

Calculated Individual Generator Set Step Load Requirements

Running kW:	49.7	Starting kW:	127.4	Cumulative Step kW:	211.6
Running kVA:	55.3	Starting kVA:	354.0	Cumulative Step kVA:	444.5
Running Amps:	66.6				
Alternator kW:	49.7				

60hp Booster Pump Three Phase Quantity: 1 In this Step

Category:	Motor				
Running kW:	49.7	Starting kW:	127.4	Peak kW:	None
Running kVA:	55.3	Starting kVA:	354.0	Peak kVA:	None
Running PF:	0.90	Starting PF:	0.36	Cyclic:	No
Running Amps:	66.6				
Alternator kW:	49.7			Voltage:	480

Shaft HP:	60.00	Method:	Across The Line
Shaft kW:	44.76		
Efficiency:	0.9	LRkVA Factor:	5.9
Design:	Standard NEMA Design B, C, or D	LRkVA Code:	G

Step 5

Calculated Individual Generator Set Step Load Requirements

Running kW:	49.7	Starting kW:	127.4	Cumulative Step kW:	261.4
Running kVA:	55.3	Starting kVA:	354.0	Cumulative Step kVA:	499.7
Running Amps:	66.6				
Alternator kW:	49.7				

60hp Booster Pump Three Phase Quantity: 1 In this Step

Category:	Motor				
Running kW:	49.7	Starting kW:	127.4	Peak kW:	None
Running kVA:	55.3	Starting kVA:	354.0	Peak kVA:	None

Running PF:	0.90	Starting PF:	0.36	Cyclic:	No
Running Amps:	66.6				
Alternator kW:	49.7			Voltage:	480
Shaft HP:	60.00	Method:		Across The Line	
Shaft kW:	44.76				
Efficiency:	0.9	LRkVA Factor:		5.9	
Design:	Standard NEMA Design B, C, or D	LRkVA Code:		G	

Step 6

Calculated Individual Generator Set Step Load Requirements

Running kW:	49.7	Starting kW:	127.4	Cumulative Step kW:	311.1
Running kVA:	55.3	Starting kVA:	354.0	Cumulative Step kVA:	555.0
Running Amps:	66.6				
Alternator kW:	49.7				

60hp Booster Pump

Three Phase

Quantity: 1 In this Step

Category: Motor

Running kW:	49.7	Starting kW:	127.4	Peak kW:	None
Running kVA:	55.3	Starting kVA:	354.0	Peak kVA:	None
Running PF:	0.90	Starting PF:	0.36	Cyclic:	No
Running Amps:	66.6				
Alternator kW:	49.7			Voltage:	480

Shaft HP:	60.00	Method:		Across The Line	
Shaft kW:	44.76				
Efficiency:	0.9	LRkVA Factor:		5.9	
Design:	Standard NEMA Design B, C, or D	LRkVA Code:		G	

Step 7

Calculated Individual Generator Set Step Load Requirements

Running kW:	49.7	Starting kW:	127.4	Cumulative Step kW:	360.8
Running kVA:	55.3	Starting kVA:	354.0	Cumulative Step kVA:	610.3
Running Amps:	66.6				
Alternator kW:	49.7				

60hp Booster Pump

Three Phase

Quantity: 1 In this Step

Category: Motor

Running kW:	49.7	Starting kW:	127.4	Peak kW:	None
Running kVA:	55.3	Starting kVA:	354.0	Peak kVA:	None
Running PF:	0.90	Starting PF:	0.36	Cyclic:	No
Running Amps:	66.6				
Alternator kW:	49.7			Voltage:	480

Shaft HP:	60.00	Method:		Across The Line	
Shaft kW:	44.76				
Efficiency:	0.9	LRkVA Factor:		5.9	
Design:	Standard NEMA Design B, C, or D	LRkVA Code:		G	

Step 8

Calculated Individual Generator Set Step Load Requirements

Running kW:	82.0	Starting kW:	182.9	Cumulative Step kW:	466.0
Running kVA:	90.1	Starting kVA:	590.0	Cumulative Step kVA:	901.5
Running Amps:	108.5				
Alternator kW:	82.0				

100hp Well_ATL

Three Phase

Quantity: 1 In this Step

Category: Motor

Running kW:	82.0	Starting kW:	182.9	Peak kW:	None
Running kVA:	90.1	Starting kVA:	590.0	Peak kVA:	None
Running PF:	0.91	Starting PF:	0.31	Cyclic:	No
Running Amps:	108.5				
Alternator kW:	82.0			Voltage:	480

Shaft HP:	100.00	Method:	Across The Line
Shaft kW:	74.60		
Efficiency:	0.91	LRkVA Factor:	5.9
Design:	Standard NEMA Design B, C, or D	LRkVA Code:	G

Step 9

Calculated Individual Generator Set Step Load Requirements

Running kW:	280.8	Starting kW:	277.5	Cumulative Step kW:	642.6
Running kVA:	305.2	Starting kVA:	1321.6	Cumulative Step kVA:	1723.2
Running Amps:	367.5				
Alternator kW:	280.8				

350hp Well_80% RVAT

Three Phase

Quantity: 1 In this Step

Category: Motor

Running kW:	280.8	Starting kW:	277.5	Peak kW:	None
Running kVA:	305.2	Starting kVA:	1321.6	Peak kVA:	None
Running PF:	0.92	Starting PF:	0.21	Cyclic:	No
Running Amps:	367.5				
Alternator kW:	280.8			Voltage:	480

Shaft HP:	350.00	Method:	Auto Transformer
Shaft kW:	261.10	Tap:	80 %
Efficiency:	0.93	LRkVA Factor:	5.9
Design:	Standard NEMA Design B, C, or D	LRkVA Code:	G

1.0 GENERAL

1.1 SUMMARY

a. Electric Utility Charges:

1. Electric Utility charges for extension of distribution system to point of service termination and meters will be paid by Owner.

1.2 DEFINITIONS

- a. Electric Utility: Local Electric Power Company.

1.3 QUALITY ASSURANCE

a. Regulatory Requirements:

1. National Fire Protection Association (NFPA):
 - (a) NFPA No. 70-93 - National Electrical Code (NEC).

2.0 PRODUCTS

2.1 ELECTRIC SERVICE

a. Electric Service Characteristics:

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

3.0 EXECUTION

3.1 PREPARATION

a. Confirmation of Electric Service:

1. Consult with Electric Utility to verify service information specified and shown on Drawings.
2. Include deviations required by Electric Utility from contract documents to comply with Electric Utility standards and requirements.

- b. Metering:
 - 1. Consult with Electric Utility regarding service entrance requirements and metering equipment.
 - 2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.

- c. Application for Electric Service.
 - 1. Obtain required forms from Electric Utility.
 - 2. Assist Owner in completion of forms and deliver completed forms to Electric Utility.
 - 3. Coordinate schedule for installation of electric service with Electric Utility.

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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.

SECTION 16402
UNDERGROUND DUCT BANKS

- 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.

SECTION 16402
UNDERGROUND DUCT BANKS

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 indicated.

- c. **Signal and Communications:** For telephone, alarm, instrumentation and communication systems, provide #4 AWG minimum green insulated copper conductor in raceway from grounding electrode system to each terminal cabinet or central equipment location.

- d. **Ground separately derived systems** required by NEC to be grounded in accordance with NEC paragraph 250-26.

- 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 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.

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

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.

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

- 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.

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

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.

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

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.

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

- (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

SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

- 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).

SECTION 16476
DISCONNECTS AND CIRCUIT BREAKERS

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.

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.

SECTION 16476
DISCONNECTS AND CIRCUIT BREAKERS

- 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) $\frac{1}{2}$ 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.

SECTION 16481
MOTOR CONTROLLERS

- (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. Motor-control centers (MCCs) for use on ac circuits rated 600 V or less.
- b. Overcurrent protective devices and disconnect switches used with motor control centers (MCCs) are specified in Section 16475.

1.2 REFERENCES

- a. American National Standards Institute (ANSI):
 - 1. ANSI C2-90 - National Electrical Safety Code (NESEC).
- b. International Electrical Testing Association (P.O. Box 687, Morrison, CO 80465):
 - 1. ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- c. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250-89 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 2-88 - Industrial Control Devices, Controllers and Assemblies.
 - 3. NEMA ICS 2.3-88 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
- d. Underwriters Laboratories (UL):
 - 1. UL 486A-89 - Wire Connectors and Soldering Lugs for Use With Copper Conductors.
 - 2. UL 845-89 - Motor Control Centers.

1.3 SUBMITTALS

- a. Submit the following for Engineer's approval.
- b. Shop Drawings:

SECTION 16482
MOTOR-CONTROL CENTERS (600V OR LESS)

1. Each MCC including dimensioned plans and elevations and component lists.
 2. Show ratings, including short-time and short-circuit ratings, and horizontal and vertical bus ampacities.
 3. Schedule of features, characteristics, ratings, and factory settings of individual MCC units.
 4. Wiring Diagrams: Interconnecting wiring diagrams pertinent to class and type specified for MCC. Schematic diagram of each type of controller unit indicated.
- c. Product Data:
1. Each product and component specified.
- d. Test Results:
1. Certified reports of field tests and observations.
- e. Operations and Maintenance Data:
1. Maintenance data for MCCs.

1.4 QUALITY ASSURANCE

- a. Items provided under this section shall be listed and labeled by UL or other Nationally recognized Testing Laboratory (NRTL). This includes complete MCC and switchgear assembly, including controls section.
1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.
- b. Regulatory Requirements:
1. National Electrical Code: Components and installation shall comply with NFPA 70.
- c. Manufacturer's Qualifications: Manufacturer shall be a member of NEMA, regularly engaged in manufacturing LV MCCs complying with requirements of these Specifications, and experienced with at least 5 projects of similar size and scope.

SECTION 16482
MOTOR-CONTROL CENTERS (600V OR LESS)

d. Product Selection for Restricted Space: Drawings indicate maximum dimensions for MCCs including clearances between MCCs and adjacent surfaces and items and are based on types and models indicated. MCCs of other manufacturers having equal performance characteristics and complying with indicated maximum dimensions may be considered.

1.5 DELIVERY, STORAGE, AND HANDLING

- a. Deliver in shipping splits of lengths that can be moved past obstructions.
- b. Store so condensation will not occur on or in MCCs. Provide temporary heaters as required to prevent condensation.
- c. Handle MCCs in accordance with NEMA ICS 2.3, "Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory-installed lifting provisions.

1.6 MAINTENANCE

- a. Extra Materials:
 - 1. Spare Fuses: Furnish one spare for every five of each type and rating of fuse and fusible devices installed, but not less than one set of three of each kind. Include spares for:
 - (a) Control power fuses.
 - (b) Fuses and fusible devices for fused circuit breakers.
 - (c) Fuses for fusible switches.
 - 2. Spare Indicating Lights: Furnish 5 of each type installed.
 - 3. Touch-Up Paint: Furnish 3 half-pint unopened containers.

2.0 PRODUCTS

2.1 MANUFACTURERS

- a. Square D Co.
- b. General Electric
- c. Eaton Corp./Cutler-Hammer Products.
- d. Or Equal.

2.2 MOTOR-CONTROL CENTERS

- a. Wiring Classification: Class I, Type B, as defined in NEMA ICS 2.
- b. Enclosure: NEMA Type 1, gasketed, as defined in NEMA 250, except as otherwise indicated.
- c. Compartments:
 - 1. Modular, with individual doors with concealed hinges and quick-captive screw fasteners.
 - 2. For combination starter units provide interlocks so disconnect means must be in off position before door can be opened, and so door cannot be closed with disconnect means in on position, except by consciously operating permissive release device.
- d. Interchangeability:
 - 1. Construct compartments so it is possible to remove units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in control center.
 - 2. Units requiring same size compartment shall be interchangeable, and compartments shall be constructed to permit ready rearrangement of units such as replacing 3 single units with unit requiring 3 spaces without cutting or welding.
- e. Wiring Spaces:
 - 1. Provide each vertical section of structure with horizontal and vertical wiring spaces for wiring to each unit compartment in each section.
 - 2. Provide separate door over vertical wiring space.
 - 3. Provide supports to hold wiring rigidly in place.
- f. Meet current NEC requirements for service entrance.
- g. Ratings: Provide nominal system voltage, continuous main bus amperage, and short-time and short-circuit-current ratings as indicated and conform with short circuit and coordination study.

2.3 BUSES

- a. Material: Tin plated copper.
- b. Ampacity Ratings: As indicated for horizontal main buses and vertical bus sized for indicated loads or 300A minimum.
- c. Neutral Buses: Full size.
- d. Equipment Ground Bus: Non-insulated, horizontal copper bus 2 inches by 1/4 inch, minimum.
- e. Horizontal Bus Arrangement: Extend main phase, neutral and ground buses with same capacity entire length of MCC unless otherwise indicated, and provision for future extension at both ends by means of bolt holes and captive bus splice sections or approved equivalent.
- f. Natural Disconnect Link: For switchgear assembly having main service disconnect. Arrange to permit disconnecting the switchgear assembly neutral bus from the common ground bus and the incoming service neutrals. Also provide a bolted, un-insulated, 1/4-in. by 2-in. copper bus (main bonding jumper). Arrange to interconnect the neutral and the ground buses to establish the system common ground point.
- g. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

- a. General: Provide modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.
- b. Motor Controller Units:
 - 1. Combination controller units; of types and with features, ratings, and circuit assignments indicated.
 - 2. Units with full-voltage, across-the-line, magnetic controllers up to and including Size 3 shall be installed on drawout mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions.
 - 3. Units shall have short-circuit current ratings equal to or greater than short-circuit current rating of MCC section.

SECTION 16482
MOTOR-CONTROL CENTERS (600V OR LESS)

4. Units in MCCs shall be equipped with pull-apart terminal strips or drawout terminal boards for external control connections.
- c. Overcurrent Protective Devices:
1. Provide types of devices with features, ratings, and circuit assignments indicated, as specified in Section 16475.
 2. Individual feeder tap units through 225 ampere rating shall be installed on drawout mountings with connectors that automatically line up and connect with vertical section buses while being racked into their normal energized positions.
- d. Spaces and Blank Units: Compartments fully bussed and equipped with guide rails or equivalent, ready for insertion of drawout units.
- e. Spare Units: Type, sizes, and ratings as indicated, and installed in compartments indicated "spare."

2.5 IDENTIFICATION PRODUCTS

- a. Provide identifying devices.
- b. Equipment Markers: Provide 2-ply, 1/8-in. thick laminated plastic, engraved equipment markers.
1. Color: Black letters on white background.
 2. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - a. Equipment name (i.e. motor control center).
 - b. Equipment Tag No. (i.e. 30-MCC-1).
 3. Size: Provide approximate 3-in. by 6-in. (minimum) for equipment.
 - a. 1-in. high letters for equipment tag number.
 - b. 1/2-in. high letters for descriptive equipment name.
 4. Size: Provide approximate 1-1/2 in. by 3-in. (minimum) for device or component.
 - a. 1/4-in. high letters for equipment tag number.
 - b. 1/4-in. high letters for descriptive equipment name.

5. Fasteners: Self-tapping stainless steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.6 FINISHES

- a. Manufacturer's standard finish suitable for environment in which installed.

2.7 CONCRETE BASES

- a. Class "B" as specified in Part 3.

3.0 EXECUTION

3.1 INSTALLATION

- a. General: Install MCCs in accordance with NEMA ICS 2.3 "Instructions for Handling, Installation, Operation, and Maintenance of MCCs," and with manufacturer's written installation instructions.
- b. Anchor each motor-control center assembly to concrete base in accordance with manufacturer's recommendations. Level and grout sills flush with motor-control center mounting surface.
- c. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from MCC units and components.

3.2 CONCRETE BASES

- a. Where concrete slab is indicated under MCC location, provide 4-in. high concrete foundation pad or, as shown on Plans.

3.3 IDENTIFICATION

- a. Identify field-installed wiring and components and provide warning signs, as specified in Section 16195.
- b. Place wire identification tags at each end of all conductors.

3.4 CONNECTIONS

- a. Tighten MCC bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's installation instructions and torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.

3.5 COORDINATION STUDY (Not Applicable)

3.6 FIELD QUALITY CONTROL

- a. Manufacturer's Field Services:

1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum of 2 workdays, travel time excluded, for assistance during plant startup, equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of:
 - (a) 2 mandays for Instructional Services.
2. Supplier or manufacturer shall direct services to specific system and equipment operation, maintenance, and troubleshooting.

- b. Testing:

1. Comply with applicable requirements of InterNational Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems."
2. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include record of repairs and adjustments made.
3. Perform following tests:
 - (a) Test insulation resistance of MCC buses; components; and of connecting supply, feeder, and control circuits. For components with solid-state devices or other sensitive components, perform tests in accordance with manufacturer's instructions.
 - (b) Make continuity tests of circuits.
 - (c) Inspect MCCs for defects and physical damage, testing laboratory labels, circuit connections, and nameplate compliance with up-to-date system drawings.
 - (d) Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.

SECTION 16482
MOTOR-CONTROL CENTERS (600V OR LESS)

- (e) Check MCC anchorage, external clearances, and alignment and fit of components including internal elements.
 - (f) Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - (g) Perform visual and mechanical inspection and related work for motor control and protective devices.
 - (h) Device Ratings and Settings: Verify ratings and settings of overload relays, motor circuit protectors, and overcurrent protective devices.
4. Quality Control Testing Program: Assure MCC installation meets specified requirements, is operational within specified tolerances, and provides appropriate protection for systems and equipment.
- (a) Test and inspect MCCs in accordance with manufacturer's recommendations and these specifications.
 - (b) Schedule tests and provide notification at least 7 days in advance of test commencement.
 - (c) Reports: Prepare written reports of test results and observations. Report defective materials and workmanship. Include complete records of adjustments and corrective action taken.
 - (d) Labeling: On satisfactory completion of tests and related effort, apply label to tested components indicating results, person responsible, and date.
 - (e) Test insulation resistance of buses and portions of control wiring that disconnect from solid-state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.
 - (f) Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformers and control power wiring.
 - (g) Check phasing of supply source to bus.
 - (h) Test motor-control devices.
 - (i) Test overcurrent protective devices.
5. Retesting: Correct deficiencies and retest. Verify by retests that specified requirements are met.

3.7 CLEANING

- a. Inspect interior and exterior of MCCs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 PROTECTION

- a. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each section of switchgear throughout periods during which the switchgear is not in a space that is continuously under normal control of temperature and humidity.

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1.0 GENERAL

1.1 SUMMARY

a. Section Includes:

1. Delayed transition automatic transfer switches to automatically transfer between normal and standby power sources.

1.2 REFERENCES

a. National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code (NEC)

b. National Electrical Manufacturer's Association (NEMA)

1. NEMA ICS 2-447- AC Automatic Transfer Switches

c. Underwriters Laboratories (UL)

1. UL 1008 - Standard for Automatic Transfer Switches

1.3 SUBMITTALS

a. Manufacturer shall submit shop drawings for review, which shall include the following, as a minimum:

1. Descriptive literature
2. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.
3. Schematic diagrams.
4. Wiring diagrams.
5. Accessory list.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- a. Zenith
- b. ASCO
- c. Onan
- d. Lexington
- e. Pre-approved equal

2.2 CONSTRUCTION

- a. General
 - 1. The delayed transition automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown. Switches shall be UL listed in accordance with UL-1008.
 - 2. On 3 phase, 4 wire systems, utilizing ground fault protection, a true 4 pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
 - 3. The transfer switch shall be mounted in a NEMA 1 enclosure, for indoors and NEMA 4X S.S. for outdoors, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008. Outdoor enclosures shall have no exposed controls.
 - 4. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
 - 5. The transfer switch shall be top and bottom accessible.
 - 6. The main contacts shall be capable of being replaced without removing the main power cables.
 - 7. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.

8. All bolted bus connections shall have Belleville compression type washers.
9. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
10. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.
11. The switch shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.
12. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

b. Automatic Transfer Switch

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.
2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungston alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable unless specifically shown on plans.
3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall be front accessible and shall provide "quick make-quick break" operation, offering the same contact to contact transfer speed as the electrical operator to prevent switching the main contacts slowly. The external manual operator shall be UL listed for operation, under load, from the outside of the transfer switch while the door is closed.

c. Automatic Transfer Switch Controls

1. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller

shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.

2. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit
3. The controller shall use industry standard open architecture communication protocol for high speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.
4. The serial communication port shall allow interface to either the manufacturer's or the owner's furnished remote supervisory control.
5. The controller shall have password protection required to limit access to qualified and authorized personnel.
6. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
7. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
8. The controller shall be capable of storing the following records in memory for access either locally or remotely:
 - (a) Number of hours transfer switch is in the emergency position (total since record reset).
 - (b) Number of hours emergency power is available (total since record reset).
 - (c) Total transfer in either direction (total since record reset).
 - (d) Date, time, and description of the last four source failures.
 - (e) Date of the last exercise period.
 - (f) Date of record reset.

d. Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall

close to start the generating plant.

2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

e. Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 10 seconds.
5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.

SECTION 16496
AUTOMATIC TRANSFER SWITCH

6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 10 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
13. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating plant programmable in one minute increments. Also include selection of either "no load" (switch will not transfer) or "load" (switch will transfer) exercise period. Keypad initiated.
14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of it's rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
15. Two auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, one closed on normal, the other closed on emergency. Both contacts will be wired to a terminal strip for ease of customer connections.
16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.

17. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
18. An LCD readout shall display normal source and emergency source availability.
19. Contacts for "Transfer Impending", adjustable 0-120 SEC.

f. Ratings

1. Delayed transition automatic transfer switches shall have the following 3 cycle short circuit closing and withstand as follows:

RMS Symmetrical Amperes 480 VAC

<u>Amperes</u>	<u>Closing and Withstand</u>	<u>Current Limiting Fuse Rating</u>
100-400	42,000	200,000
600-800	65,000	200,000
1000-1200	85,000	200,000
1600-4000	100,000	200,000

2. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contacts separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.
3. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.
4. The microprocessor controller shall meet the following requirements:
 - Storage conditions - 25 degrees C to 85 degrees C
 - Operation conditions - 20 degrees C to 70 degrees C ambient
 - Humidity 0 to 99% relative humidity, noncondensing
 - Capable of withstanding infinite power interruptions
 - Surge withstand per ANSI/IEEE C-37.90A-1978

5. Manufacturer shall provide copies of test reports upon request.
- g. Manufacturer
1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.
 2. The manufacture shall include an 800 telephone number, for field service contact, affixed to each enclosure.
 3. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum 20 years.
- h. Warranty
1. Provide 5 year standard manufacturer's warranty consisting of 2 years parts and labor, and an additional 3 years of replacement parts. Warranty shall be "on site" and warranty service shall be available by the factory service department on an emergency basis if required. Depot or non site warranties are not acceptable.

3.0 EXECUTION

3.1 INSTALLATION

- a. Automatic Transfer Switches shall be provided with adequate lifting means for ease of installation of wall or floor mounted enclosures.
- b. Provide access and working space as indicated or as required.

3.2 ADJUSTMENTS

- a. Tighten assembled bolted connections with appropriate tools to manufacturer's torque recommendations prior to first energization.

3.3 START-UP AND TESTING

- a. Provide the services of a factory representative to check-out, test, and start-up the automatic transfer switch in conjunction with the standby generator. Fully function test the automatic transfer switch to verify proper operation.

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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.

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PART 1 GENERAL

1.01 SECTION INCLUDES

This section specifies furnishing and installing a weatherproof sound attenuating enclosure around the standby emergency power generators at the water plant and the wastewater treatment plant.

1.02 REFERENCE STANDARDS

- A. Furnish and install a weatherproof sound attenuating enclosure designed to reduce the noise level of the standby emergency power generator set. The overall acoustical performance shall reduce the unsilenced noise levels 3 ft. from all sides and at 5 ft. elevation and at 3 ft. above the enclosure to 84 db or less.
- B. Wall construction and cooling baffle or silence construction shall be independently tested in conformance with ASTM procedures C423 for sound absorption, E90 for transmission loss, E413 for sound transmission class and E477 for silencer acoustical performance (Dynamic Insertion Loss).
- C. In addition to these minimum acoustical performance numbers, the enclosure shall meet the following fire related parameters per NFPA No. 255 or ASTM E84. Flame spread = 15, smoke developed = 0, and fuel contributed = 0.
- D. General enclosure design shall be able to withstand the following loadings: 100 mph winds, 42 lbs./ft. Roof loads.

1.03 RELATED WORK

- A. Division 16 - Electrical Specifications that apply to the requirements of this project.

1.04 PRODUCT

A. Construction

- 1. General construction of the enclosure walls and roof shall consist of dual wall, prefabricated tongue-and-groove type acoustic panels with a 16 gauge, galvanized steel outer skin; a 22 gauge, perforated galvanized steel inner skin; roll formed internal channel stiffers and framing; and 3 lbs/cu. ft. density mineral glass fiber acoustical/ thermal insulation completely filling the void between the inner and outer skins. Also included shall be a 2 mil mylar protective liner installed between the perforated inner skin and the insulation material. An acoustical labyrinth shall be achieved at each panel joint or seam.

SECTION 16622
SOUND ATTENUATING ENCLOSURE

2. The enclosure's super structure will consist of a structural rectangular tube frame work. The structure shall consist of two full length base members, six full width base members, four full height corner columns, and two full width roof beams. This structure shall be completely seal welded at each connection point and all open tube ends will be capped with seal welded plates. Lifting eyes rated at a safe working load of 8,000 pounds each (for units that weigh more than 6,000 pounds) or 6,000 pounds each (for units that weigh less than 6,000 pounds) shall be installed at the top of each structural tube steel corner column. Anchor bolt clips shall be located and installed along the inside perimeter of the structural tube steel base frame.
3. All doors will be factory mounted in a separate, self supporting, welded steel frame. All door hardware will be factory mounted. Door hardware to include chrome-plated Polar brand slam locks with exit bar, two-point slam and take-up locks with inside release handle, Kason brand 1061BB ball bearing heavy duty hinges, and positive type stainless steel door holders. Doors shall have neoprene or EPDM perimeter gasketing. Door shall seal completely along gasketed perimeter.
4. Acoustical treatment of the cooling air intake and discharge opening shall be achieved with straight-through type, full height vertical baffles. Each baffle shall be of a one-piece construction. Construction of each baffle shall include a galvanized steel frame and stiffeners, perforated galvanized steel skin, roll-formed galvanized steel end caps, and acoustical insulation completely filling the void between the perforated skins. Each baffle must be easily removable to allow for completely open ends. Removal of the baffles shall not affect structural integrity of the enclosure's walls and roof. Silencers mounted externally from the enclosure are not acceptable.
5. In addition to the cooling air intake/discharge openings being acoustically treated, a set of 6" deep stationary weather louvers with birdscreens shall be supplied. These louvers shall be mounted to the enclosure's structural tube steel frame at each end of the enclosure. Louvers are to be removable and have lifting eyes to aid in removal.
6. Forced air ventilation and interior lighting shall be provided and connected to a 12 circuit (minimum) NEMA 1 surface mounted lighting panel complete with (12) 20A plug-in circuit breakers and 10 KVA encapsulated 480/120-240V transformer.
7. Provide approved concrete or steel stairs and platform where required for grade level access to generator enclosure.

B. Manufacturers

1. Acceptable manufacturers are:

- a. Acoustical Control Systems, Inc.
- b. Engine and Compressor Accessories (ECA)
- c. Manufacturer's Sound Enclosure, provided it meets the Sound Attenuation Requirements shown in Section 1.02.A.

1.05 SUBMITTALS

- A. Submit all products covered under this specification for Engineer=s approval.
- B. Submit the following information to the Engineer for approval prior to placing any equipment on order:
- C. Dimensional Drawings. Submit dimensional drawings of the sound attenuating enclosure and accessories.
- D. Test Report. Furnish a certified copy of the factory test report on the actual enclosure provided.

1.06 INSTALLATION

Install sound alternating enclosure according to plans.

PART 2 PRODUCTS (Not Used)

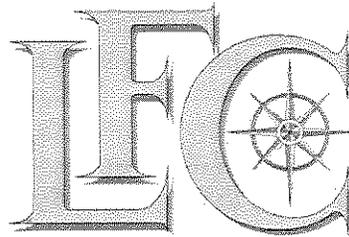
PART 3 EXECUTION (Not Used)

END OF SECTION

**GEOTECHNICAL ENGINEERING REPORT
Water Supply and Storage Facility No. 3
Tomball, Texas**

Prepared by:

LFC, Inc.



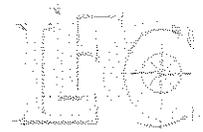
Prepared For:

**Cobb, Fendley & Associates
13430 Northwest Freeway, Suite 1100
Houston, Texas 77040**

Attention: Ms. Amber Hurd, P.E.

February 2009

Project No. 09-0065



February 13, 2009

Ms. Amber Hurd, P.E.
Cobb, Fendley & Associates
13430 Northwest Freeway, Suite 1100
Houston, Texas 77040

**Re: GEOTECHNICAL ENGINEERING REPORT
Water Supply and Storage Facility No. 3
Tomball, Texas
LFC Project No. 09-0065**

Dear Ms. Hurd:

Submitted herewith are the results of a geotechnical investigation conducted for the referenced project. This investigation was performed in accordance with our proposals P08-0572 dated October 22, 2008, and P09-0009 dated January 8, 2009.

Engineering analyses and recommendations for site grading and foundations are contained in the narrative section of the report. Results of our field and laboratory investigation are submitted in detail in the Appendices of the report.

We appreciate the opportunity to be of service to you on this project, and we would appreciate the opportunity to provide the materials engineering-testing and geotechnical observation services during the construction phase of this project. Please contact us if you have any questions or need any additional services.

Respectfully Submitted,

Daryl Poduska / 13 Feb. 09

Daryl Poduska, P.E.
Geotechnical Services Manager

DJP / for

Kenneth B. Riner, P.E.
President

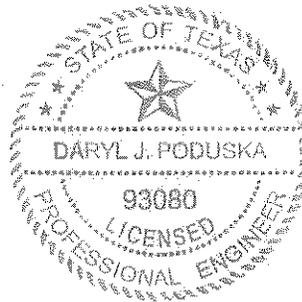


Table of Contents

	<u>Page</u>
1.0 Introduction.....	1
2.0 Field Operations and Laboratory Testing	1
3.0 General Site Conditions.....	2
3.1 Site Geology	2
3.2 Subsurface Soil Conditions	2
3.3 Groundwater	3
4.0 Analysis and Recommendations	3
4.1 Seismic Site Classification	3
4.2 Potential Vertical Soil Movements.....	3
4.3 Earthwork Recommendations	4
4.4 Water Storage Tank Recommendations	4
4.4.1 Foundation System – Ring Wall Foundation	4
4.4.2 Subgrade Preparation	5
4.4.3 Piping Connections	5
4.5 Control Building Recommendations.....	5
4.5.1 Foundation System - Slab	5
4.5.2 Foundation System – Shallow Footings	6
4.5.3 Foundation System - Drilled Piers	7
4.5.4 Slab-on-Grade Recommendations	8
4.6 Fill Recommendations	9
4.7 General	9
4.8 Density Tests	10
5.0 Site Preparation and Grading	10
5.1 Site Preparation	10
5.2 Site Grading	10
6.0 Construction Observations	10
7.0 Report Closure	11

Appendices

- Appendix A - Project Location Diagram
- Appendix B - Boring Location Diagram
- Appendix C - Geologic Atlas
- Appendix D - Boring Log(s)
- Appendix E - Unified Soil Classification System
- Appendix F - Field Operations and Laboratory Testing

GEOTECHNICAL ENGINEERING REPORT

Water Supply and Storage Facility No. 3

Tomball, Texas

1.0 Introduction

The proposed project will consist of the construction of a 500,000-gallon water tank and control building located approximately 1,000-feet west of the intersection of Tomball Cemetery Road and FM 2920 (also known as Waller Tomball Road) in Tomball, Texas. The water tank will be 55-feet in diameter and 32-feet high. We have assumed that building loads for the control building will be light and that cuts of less than 1-foot will be required to bring the site to grade. The general location and orientation of the site are shown on the Project Location Diagram, located in the Appendix A of this report.

The principal purposes of this investigation were to evaluate the general soil conditions at the proposed site and to develop geotechnical recommendations for the design and construction of building foundations. To accomplish its intended purposes, the study was conducted in the following phases: (1) drill sample borings to evaluate the soil conditions at the boring locations and to obtain soil samples; (2) conduct laboratory tests on selected samples recovered from the borings to establish the pertinent engineering characteristics of the soils; and (3) perform engineering analyses, using field and laboratory data, to develop design criteria.

2.0 Field Operations and Laboratory Testing

The subsurface investigation consisted of three borings, B-01 and B-02, drilled on December 1, 2008, and B-03 drilled on January 26, 2009. Borings B-01 and B-03 were drilled near the proposed storage tank to depth of 15- and 50-feet below ground surface (bgs), respectively. Boring B-02 was drilled to a depth of 15-feet bgs near the proposed control building.

The locations of the borings are shown on the Boring Location Diagram in Appendix B. The site mapped on a geologic atlas and a formation description are provided in Appendix C. Sample depths, description of soils, and classification (based on the Unified Soil Classification System) are presented on the boring logs in Appendix D. Terms and symbols used in the Unified Soil Classification System are presented in Appendix E.

Laboratory soil tests were performed on selected samples recovered from the borings to verify visual classification and determine the pertinent engineering properties of the soils encountered. Classification test results are presented on the boring logs.

Descriptions of the procedures used in the field and laboratory phases of this study are presented in the Appendix F of this report.

3.0 General Site Conditions

3.1 Site Geology

Based on available surface geology maps and our experience, it appears this site is located near a contact between the Lissie and Willis Formations (See Appendix C). The Lissie and Willis Formations can generally be characterized as clay, silt, and sand with some gravel.

A review of geologic maps indicated that the nearest mapped geologic fault is located approximately 8-miles southwest of the project site. A geologic fault study was beyond the scope of this investigation.

3.2 Subsurface Soil Conditions

Descriptions of the various strata and their approximate depths and thickness are shown on the boring logs. A brief summary of the stratigraphy indicated by the borings is given below.

Borings B-01 and B-03, drilled near the proposed water storage tank, encountered silty sand (SM) from the ground surface to 2-feet bgs. Between 2- and 8-feet bgs, silty sand (SM) and low plastic sandy silt (ML) was encountered. At depths of 6- to 8-feet bgs, low plastic sandy clay (CL) was encountered that extended to the bottom of B-01 at 15-feet bgs and to 20-feet bgs at B-03. At 20-feet bgs at B-03, silty sand (SM) was encountered that extended to 32-feet bgs where high plastic clay (CH) was encountered that extended to the bottom of B-03 at 50-feet bgs.

Boring B-02, drilled near the proposed control building, encountered silty sand (SM) from the ground surface to 2-feet bgs where low plastic sandy clay (CL) and clayey sand (SC) was encountered that extended to 6-feet bgs. At 6-feet bgs, low plastic sandy clay (CL) was encountered that extended to the bottom of the boring at 15-feet bgs.

Petroleum hydrocarbon odors were encountered at B-01 at a depth of 4- to 6-feet bgs.

The soils encountered at and near the ground surface at this site are very susceptible to changes in moisture. The presence of surface water or groundwater may result in a decrease in the ability to compact and work with the soil. It is common for these soils to pump when subjected to high levels of moisture. In addition, these soils located at and

near the ground surface will allow surface water to infiltrate until the water becomes perched on a less permeable layer at depth.

Atterberg (plastic and liquid) limits were performed on seven soil samples obtained at depths between 2- and 50-feet bgs. The plasticity index of the samples within the upper 4-feet of the profile ranged from non-plastic to 12 indicating that the near surface soils generally have a low potential for shrinking and swelling with changes in soil moisture content.

3.3 Groundwater

The borings were advanced using auger drilling and intermittent sampling methods in order to observe groundwater seepage levels. Groundwater was not encountered at any of the boring locations at the time of drilling. However, perched water was encountered at boring B-01 at a depth of 5-feet bgs.

Future construction activities may alter the surface and subsurface drainage characteristics of this site. It is difficult to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. The groundwater level should be expected to fluctuate throughout the years with variations in precipitation.

4.0 Analysis and Recommendations

4.1 Seismic Site Classification

The seismic site classification is based on the 2006 International Building Code (IBC) and is a classification of the site based on the type of soils encountered at the site and their engineering properties.

Per Table 1613.5.2 of the 2006 IBC, the seismic site classification for this site is D.

4.2 Potential Vertical Soil Movements

Potential Vertical Rise (PVR) calculations were performed in general accordance with the Texas Department of Transportation (TxDOT) Method Tex-124-E. The Tex-124-E method is empirical and is based on the Atterberg limits and moisture content of the subsurface soils.

The PVR calculated using the referenced method is about 1-inch assuming an average moisture condition.

4.3 Earthwork Recommendations

The subsurface investigation indicated the upper 6- to 8-feet of soil encountered at the boring locations was wet, loose, and soft. These soils are very susceptible to changes in moisture, provide low bearing capacity, and are subject to excessive settlement. Therefore, for a shallow foundation system to be viable, we recommend that the existing soils be excavated to a depth of approximately 6- to 8-feet, or until competent soil is encountered, and to at least 5-feet outside of the building footprint. The excavated soil should be replaced with select fill meeting the requirements in the section titled "Fill Recommendations". In addition, petroleum hydrocarbon odors were encountered at B-01 at depths between 4- and 6-feet bgs indicating that the existing soil may be environmentally impacted and require special handling, treatment, or disposal.

4.4 Water Storage Tank Recommendations

4.4.1 Foundation System – Ring Wall Foundation

Provided that the recommendations in the section titled "Earthwork Recommendations" are incorporated, the proposed water storage tank may bear on a ring wall foundation bearing at a minimum depth of 3-feet below surrounding grade. The foundation can be proportioned using a net dead load plus sustained live load bearing pressure of 2,000 pounds per square foot (psf) or a net total load bearing pressure of 3,000 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively. Ring wall foundations should be at least 24-inches wide.

Resistance to lateral loads may be provided by the soil adjacent to the foundation. We recommend using an allowable equivalent fluid weight of 200 pounds per cubic foot (pcf) for lateral resistance. The upper 12-inches not protected by paving or concrete should be ignored in passive resistance calculations. An allowable coefficient of sliding friction of 0.3 between the concrete footings and underlying soil may be combined with the passive resistance.

A settlement analysis was performed to calculate the estimated immediate and consolidation settlement of the tank. The short-term immediate settlement was calculated to be approximately 1-inch at the edge of the tank and approximately 1.5-inches under the center of the tank. The long-term consolidation settlement was calculated to be between 2- and 3-inches at the edge of the tank and between 4- and 5-inches under the center of the tank. The total settlement was calculated to be between 3- and 4-inches at the edge of the tank and between 5.5- and 6.5 inches under the center of the tank.

The geotechnical engineer should monitor foundation construction to verify conditions are as anticipated and that the materials encountered are suitable for support of foundations. Soft or unsuitable soils encountered at the foundation bearing level should

be removed to expose suitable, firm soil. Foundation excavations should be dry and free of loose material. Excavations for foundations should be filled with concrete before the end of the workday or sooner if necessary to prevent deterioration of the bearing surface. Prolonged exposure or inundation of the bearing surface with water will result in changes in strength and compressibility characteristics. If delays occur, the excavation should be deepened as necessary and cleaned, in order to provide a fresh bearing surface. If more than 24 hours of exposure of the bearing surface is anticipated in the excavation, a "mud slab" should be used to protect the bearing surfaces. If a mud slab is used, the foundation excavations should initially be over-excavated by approximately 4 inches and a lean concrete mud slab of approximately 4 inches in thickness should be placed in the bottom of the excavation immediately following exposure of the bearing surface by excavation. The mud slab will protect the bearing surface, maintain more uniform moisture in the subgrade, facilitate dewatering of excavations if required, and provide a working surface for the placement of formwork and reinforcing steel.

4.4.2 Subgrade Preparation

We recommend that the upper 6-inches of the tank subgrade consist of a sand pad consisting of clean sand. The sand pad should be sloped at 1-inch per 10 feet from the center to the edge of the tank to help account for the larger magnitude of settlement anticipated at the center of the tank.

4.4.3 Piping Connections

As stated previously, the tank is expected to settle between 3- and 6.5-inches over its lifetime. Therefore, we recommend that flexible connections and piping be used at joints and beneath the tank.

4.5 Control Building Recommendations

4.5.1 Foundation System - Slab

Provided that the recommendations in the section titled "Earthwork Recommendations" are incorporated, the proposed control building can be supported on a reinforced ground-supported slab foundation. The slab foundation should be conventionally reinforced or post-tension reinforced. The slab foundation should be designed with exterior and interior grade beams adequate to provide sufficient rigidity to the foundation system to sustain the vertical soil movements expected at this site as described above. All grade beams and floor slabs should be adequately reinforced with steel to minimize cracking as normal movements occur in the foundation soils.

The slab should be designed using a net dead load plus sustained live load bearing pressure of 2,000 pounds per square foot (psf) or a net total load pressure of 3,000 psf, whichever condition results in a larger bearing surface. These bearing pressures are

based on a safety factor of 3 and 2, respectively, against shear failure of the foundation bearing soils. Grade beams should be founded a minimum of 24 inches below surrounding grade and bear on select fill. The bottom of the beam trenches should be free of any loose or soft material prior to the placement of the concrete.

The recommended foundation design parameters based on information published in the Post Tensioning Institute (PTI) Design and Construction of Post-Tensioned Slabs-on-Ground, 2nd Edition, are as follows:

Edge Moisture Variation Distance	
Center Lift	4.5 feet
Edge Lift	5.5 feet
Differential Swell	
Center Lift:	0.9 inches
Edge Lift:	0.6 inches

4.5.2 Foundation System – Shallow Footings

Provided that the recommendations in the section titled “Earthwork Recommendations” are incorporated, shallow strip and spread footing foundations can be used for support of the proposed control building bearing on select fill at a depth of 2-feet below surrounding grade. Continuous strip footings can be proportioned using a net dead load plus sustained live load bearing pressure of 2,000 psf or a net total load bearing pressure of 3,000 psf, whichever condition results in a larger bearing surface. Individual spread footings can be proportioned using a net dead load plus sustained live load bearing pressure of 2,600 psf or a net total load bearing pressure of 3,900 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively. Individual spread footings should be at least 30 inches wide, and continuous strip footing foundations should be at least 16 inches wide. Although a detailed settlement analysis is beyond the scope of this study, settlement for foundations constructed as described above should be about 1 inch or less.

Resistance to lateral loads may be provided by the soil adjacent to the footings. We recommend using an equivalent fluid weight of 200 pounds per cubic foot (pcf) for lateral resistance. An allowable coefficient of sliding friction of 0.3 between the concrete footings and underlying soil may be combined with the passive resistance.

The geotechnical engineer should monitor foundation construction to verify conditions are as anticipated and that the materials encountered are suitable for support of foundations. Soft or unsuitable soils encountered at the foundation bearing level should be removed to expose suitable, firm soil. Foundation excavations should be dry and free of loose material. Excavations for foundations should be filled with concrete before the end of the workday or sooner if necessary to prevent deterioration of the bearing surface. Prolonged exposure or inundation of the bearing surface with water will result

in changes in strength and compressibility characteristics. If delays occur, the excavation should be deepened as necessary and cleaned, in order to provide a fresh bearing surface. If more than 24 hours of exposure of the bearing surface is anticipated in the excavation, a "mud slab" should be used to protect the bearing surfaces. If a mud slab is used, the foundation excavations should initially be over-excavated by approximately 4 inches and a lean concrete mud slab of approximately 4 inches in thickness should be placed in the bottom of the excavation immediately following exposure of the bearing surface by excavation. The mud slab will protect the bearing surface, maintain more uniform moisture in the subgrade, facilitate dewatering of excavations if required, and provide a working surface for the placement of formwork and reinforcing steel.

4.5.3 Foundation System - Drilled Piers

Straight shaft drilled pier foundations (auger-excavated, steel reinforced, cast-in-place concrete piers) bearing in native soil may be utilized at this site for the proposed control building. We recommend that the piers should be founded at a depth of 10- to 12-feet beneath the existing grade. The piers may be proportioned using a net dead load plus sustained live load bearing pressure of 2,000 psf or a net total load pressure of 3,000 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively, against shear failure of the foundation bearing soils. Foundation settlement for drilled piers constructed as described above should be less than 1 inch.

Because of the potential for the upper two feet of the soil to shrink and pull away from drilled piers during dry periods, we recommend soil resistance to lateral loads on drilled piers be ignored in the upper 2-feet of the soil profile. For resistance of lateral loads on drilled piers, we recommend the following parameters that include a factor of safety of 3.

Depth (ft)	Soil Type	Effective Soil Unit Weight (pcf) ⁽¹⁾	Allowable Cohesion (psf)	Angle of Internal Friction, Φ (degrees)	Strain at ½ Peak Strength, ϵ_{60}	Horizontal Modulus of Subgrade Reaction (tons per cubic foot)
0 – 2	Sand	120	0	0	NA	NA
2 – 12	Clay/Sand	120	375	0	0.007	80

(1) – Effective soil unit weight based on assumed groundwater depth greater than 10-feet.

A safety factor of 3 has been applied to the allowable cohesion value and is appropriate for sustained loading conditions. However, the allowable cohesion values may be increased by 50 percent, resulting in a safety factor of 2, for transient loading conditions.

The uplift force on the piers due to swelling of the active clays can be approximated by assuming a uniform uplift pressure of 500 psf acting over the perimeter of the shaft to a depth of 8-feet. The shafts should contain sufficient full length reinforcing steel to resist uplift forces.

The construction of all piers should be observed as a means to verify compliance with design assumptions and to verify:

1. the bearing stratum;
2. the removal of all smear zones and cuttings;
3. that groundwater seepage, when encountered, is correctly handled; and
4. that the shafts are vertical (within acceptable tolerance).

Groundwater was not encountered at any of the boring locations during the subsurface investigation. However, groundwater may be encountered during pier excavation, and the risk of groundwater seepage is increased during or after periods of precipitation. Submersible pumps may be capable of controlling seepage in the pier excavation to allow for concrete placement.

Wet and loose sand, silt, and clay were encountered from the ground surface to about 6- to 8-feet bgs. These soils are prone to sloughing and collapse when excavated. Therefore, it may be necessary to use temporary casing or drilling slurry to prevent sloughing and collapse of the drilled piers during excavation.

Drilled pier foundations should be constructed in accordance with the requirements of TxDOT Item 416 (standard specification for construction of drilled pier foundations). This specification includes requirements for construction using casing or the slurry displacement method, as appropriate. We should be contacted for further evaluation and recommendations if soils other than those anticipated to be encountered at the design foundation bearing level, or if groundwater seepage and/or underream collapse occurs.

Concrete should be placed in the shafts immediately after excavation to reduce the risk of significant groundwater seepage, deterioration of the foundation-bearing surface, and collapse. In no event should a pier excavation be allowed to remain open for more than 8 hours. Concrete should have a slump of 5 to 7 inches, and should not be allowed to strike the shaft sidewall or steel reinforcement during placement.

4.5.4 Slab-on-Grade Recommendations

Based on the information gathered during this investigation, a slab constructed on-grade will be subject to potential slab movements of about 1-inch.

The subgrade is prone to drying after being exposed and should be kept moist prior to slab placement. A moisture barrier should be used beneath the slab foundation in areas where floor coverings will be utilized (such as, but not limited to, wood flooring, tile, linoleum, and carpeting).

4.6 Fill Recommendations

Any fill placed in the building pad area should consist of select fill. Select fill should consist of soil with a liquid limit less than 35 and a Plasticity Index between 7 and 20. The select fill should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content within ± 2 percent of the optimum moisture content. The subgrade to receive select fill should be scarified to a depth of 6 inches and compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 3 percent above optimum.

General fill may be placed in improved areas outside of the building pad. General fill should consist of material approved by the Soils Engineer and with a liquid limit less than 50. General fill should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ± 2 percent of the optimum moisture content.

Select fill and general fill should consist of those materials meeting the requirements stated. Select fill and general fill should not contain material greater than 4-inches in any direction, debris, vegetation, waste material, environmentally contaminated material, or any other unsuitable material.

Materials considered unsuitable for use as select fill or general fill include low and high plastic silt (ML and MH), silty clay (CL-ML), organic clay and silt (OH and OL), and highly organic soils such as peat (Pt). These soils may be used for site grading and restoration in unimproved areas as approved by the Soils Engineer. Soil placed in unimproved areas should be placed in loose lifts not exceeding 10-inches and should be compacted to at least 92 percent maximum dry density (per ASTM D-698) and at a moisture content within ± 4 percentage points of optimum.

4.7 General

Every attempt should be made to limit the extreme wetting or drying of the subsurface soils because swelling and shrinkage of these soils will result. Standard construction practices of providing good surface water drainage should be used. A positive slope of the ground away from any foundation should be provided. Also, ditches or swales should be provided to carry the run-off water both during and after construction. Lawn areas should be watered moderately, without allowing the clay soils to become too dry or too wet. Stormwater runoff should be collected by gutters and downspouts, and should discharge away from the buildings.

Root systems from trees and shrubs can draw a substantial amount of water from the clay soils at this site, causing the clays to dry and shrink. This could cause settlement beneath grade-supported slabs such as floors, walks and paving. Trees and large

bushes should be located a distance equal to at least one-half their anticipated mature height away from grade slabs.

4.8 Density Tests

Field Density tests should be made by the Soils Engineer or his representative. Density tests should be taken in each layer of the compacted material below the disturbed surface. If the materials fail to meet the density specified, the course should be reworked as necessary to obtain the specified compaction.

5.0 Site Preparation and Grading

5.1 Site Preparation

Preparation of the site for construction operations should include the removal and proper disposal of all obstructions that would hinder preparation of the site for construction. These obstructions should include all abandoned structures, foundations, debris, water wells, septic tanks and loose material. It is the intent of these recommendations to provide for the removal and disposal of all obstructions not specifically provided for elsewhere by the plans and specifications.

All concrete, trees, stumps, brush, abandoned structures, roots, vegetation, rubbish and any other undesirable matter should be removed and disposed of properly. All vegetation should be removed and the exposed surface should be scarified to an additional depth of at least 6 inches. It is the intent of these recommendations to provide a loose surface with no features that would tend to prevent uniform compaction by the equipment to be used.

5.2 Site Grading

Site grading operations, where required, should be performed in accordance with the recommendations provided in this report. The site grading plans and construction should strive to achieve positive drainage around all sides of the proposed buildings. Inadequate drainage around structures built on-grade can cause excessive vertical differential movements to occur.

6.0 Construction Observations

In any geotechnical investigation, the design recommendations are based on a limited amount of information about the subsurface conditions. In the analysis, the

geotechnical engineer must assume the subsurface conditions are similar to the conditions encountered in the borings. However, during construction quite often anomalies in the subsurface conditions are revealed. Therefore, it is recommended that LFC, Inc. be retained to observe earthwork and foundation installation and perform materials evaluation and testing during the construction phase of the project. This enables the geotechnical engineer to stay abreast of the project and to be readily available to evaluate unanticipated conditions, to conduct additional tests if required and, when necessary, to recommend alternative solutions to unanticipated conditions. Until these construction phase services are performed by the project geotechnical engineer, the recommendations contained in this report on such items as final foundation bearing elevations, final depth of undercut of expansive soils for non-expansive earth fill pads, and other such subsurface-related recommendations should be considered as preliminary.

It is proposed that construction phase observation and materials testing commence by the project geotechnical engineer at the outset of the project. Experience has shown that the most suitable method for procuring these services is for the owner to contract directly with the project geotechnical engineer. This results in a clear, direct line of communication between the owner and the owner's design engineers, and the geotechnical engineer.

7.0 Report Closure

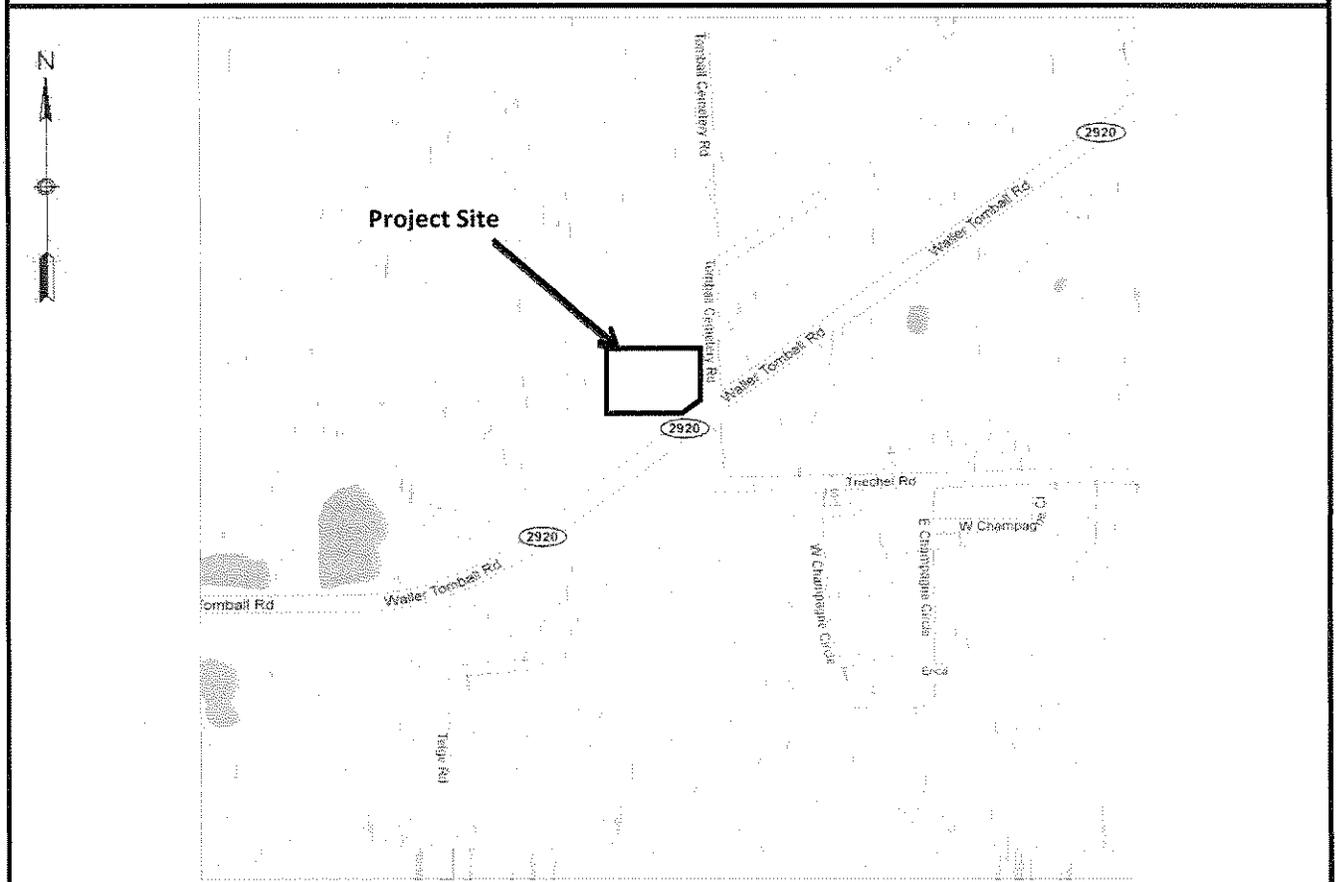
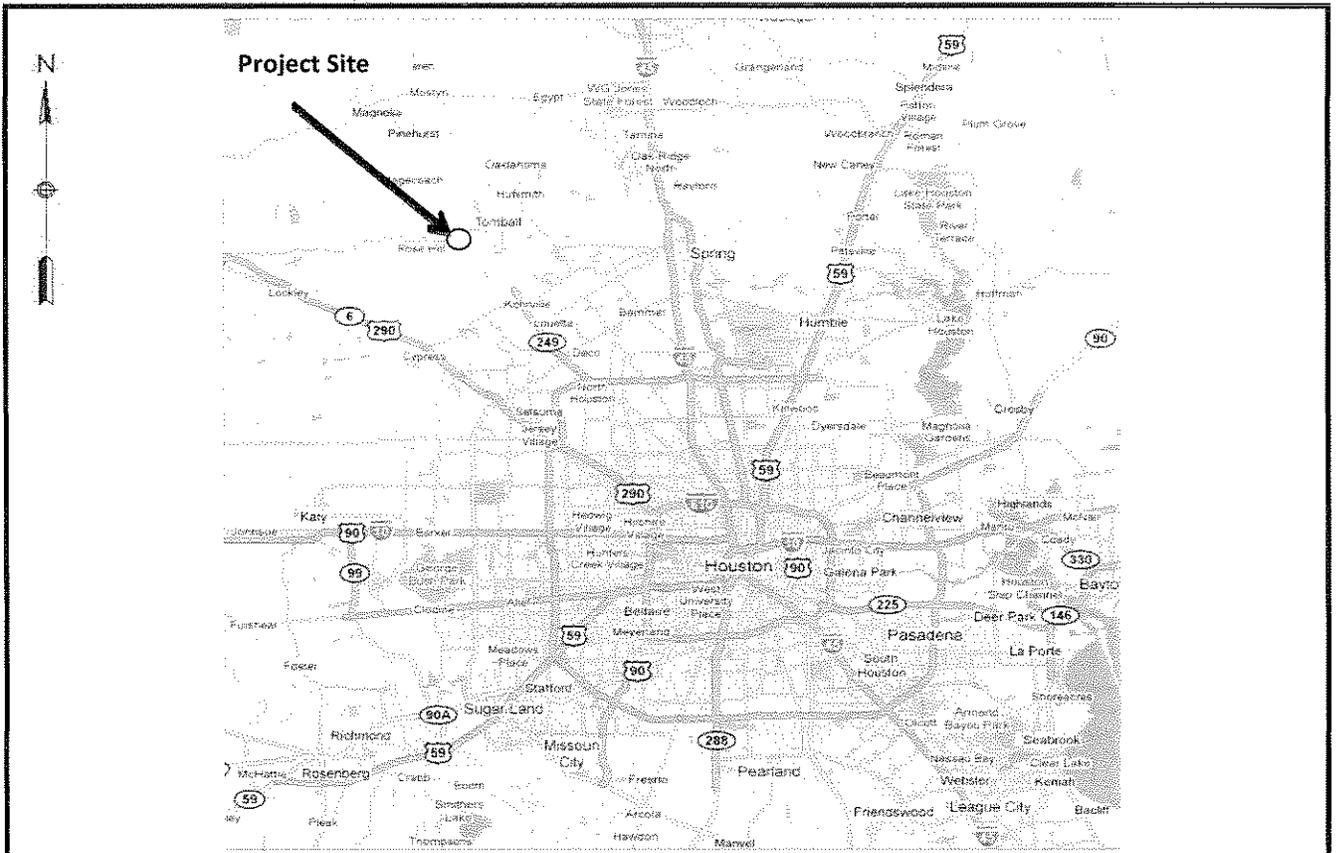
The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of the field investigation and further on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed. If during construction, different subsurface conditions from those encountered in our borings are observed, or appear to be present in excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between submission of this report and the start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if structure locations, structural loads or finish grades are changed, we urge that we be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

Further, it is urged that LFC, Inc. be retained to review those portions of the plans and specifications for this particular project that pertain to earthwork and foundations as a means to determine whether the plans and specifications are consistent with the recommendations contained in this report. In addition, we are available to observe construction, particularly the compaction of structural fill, or backfill and the construction

of foundations as recommended in the report, and such other field observations as might be necessary.

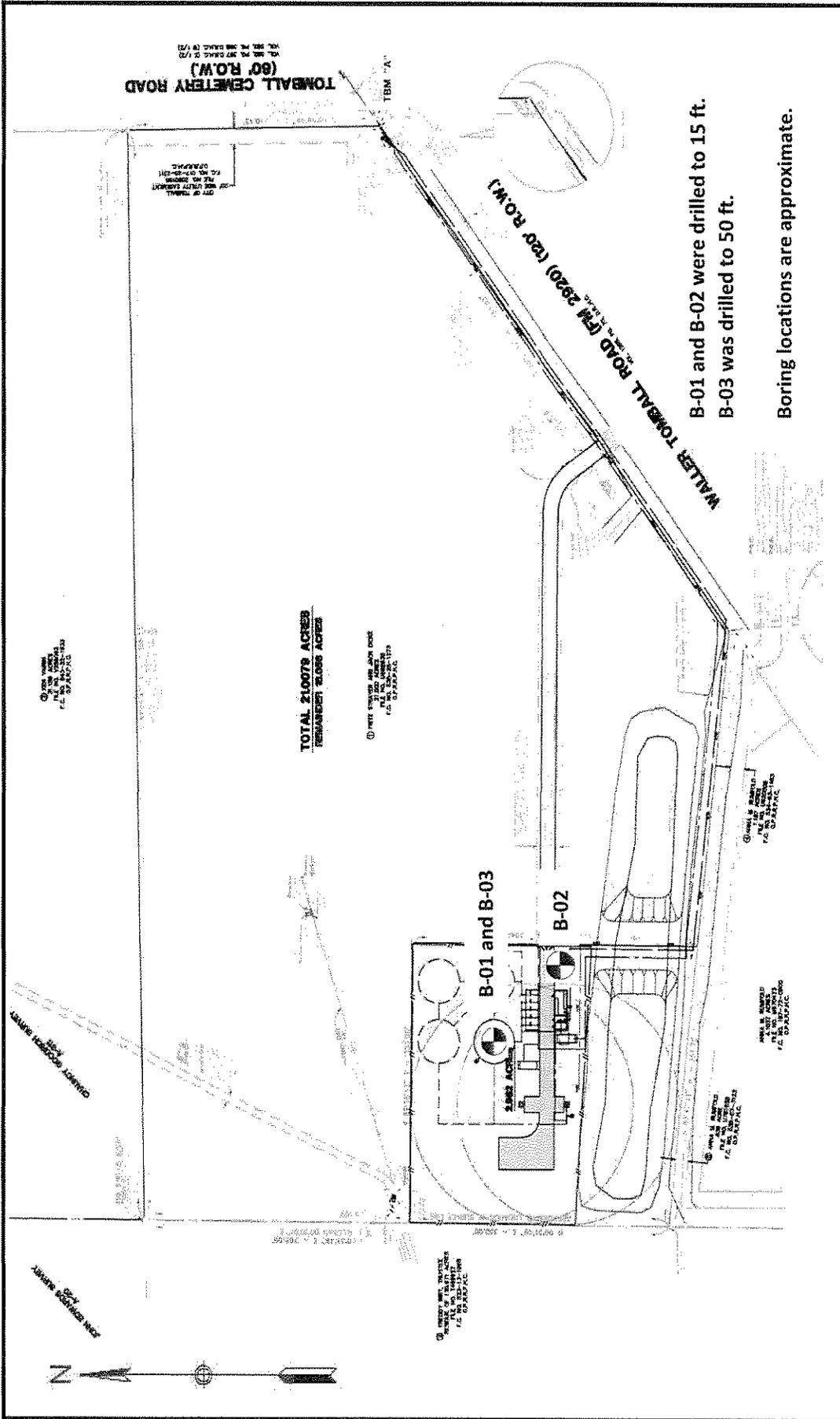
This report has been prepared for the exclusive use of the Client and their designated agents for specific application to design of this project. We have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No warranty, expressed or implied, is made or intended.

Appendix A - Project Location Diagram



	<p>PROJECT LOCATION DIAGRAM Water Supply & Storage Facility No. 3 FM 2920 and Tomball Cemetery Road, Tomball, Texas</p>	
	<p>DATE: 02/10/09</p>	<p>Project No. 09-0065</p>

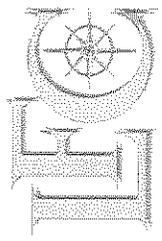
Appendix B - Boring Location Diagram



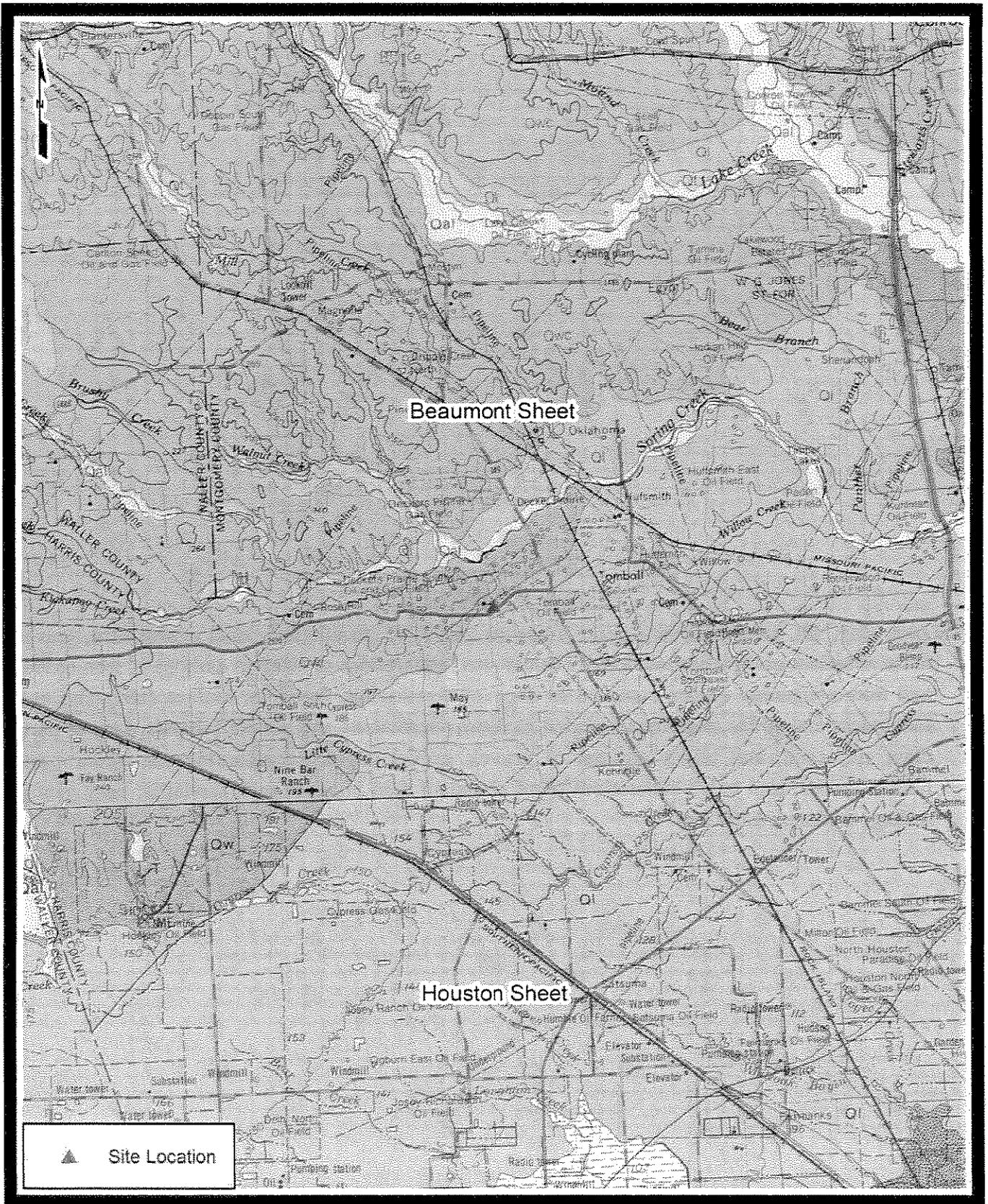
B-01 and B-02 were drilled to 15 ft.
 B-03 was drilled to 50 ft.
 Boring locations are approximate.

Project No. 09-0065
 Date - 2/09/09

BORING LOCATION DIAGRAM
 Water Supply & Storage Facility No. 3
 FM 2920 and Tomball Cemetery Road, Tomball, Texas



Appendix C - Geologic Atlas



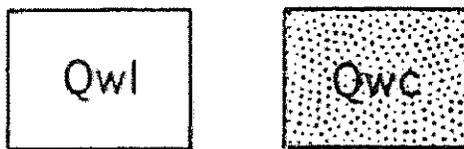
09-0065
Geologic Atlas of Texas



Q1

Lissie Formation

Upper part, clay, silt, sand, and very minor siliceous gravel of granule and small pebble size, gravel more abundant northwestward, locally calcareous, concretions of calcium carbonate, iron oxide, and iron-manganese oxides common in zone of weathering; fluvatile; surface fairly flat and featureless except for numerous rounded shallow depressions and pimple mounds. Lower part, clay, silt, sand, and minor amount of gravel; gravel slightly coarser than in upper part, noncalcareous, iron oxide concretions more abundant than in upper part; fluvatile; very gently rolling; thickness ± 200 feet



Willis Formation

Clay, silt, sand, and siliceous gravel of granule to pebble size, including some petrified wood; sand coarser than in younger units, noncalcareous; mostly deeply weathered and lateritic, indurated by clay and cemented by iron oxide locally, iron oxide concretions abundant and locally used as road material in coastward belt of outcrop, Qwc, iron oxide concretions less abundant and amount of weathering decreases eastward in landward belt of outcrop, Qwl; coastward edge of base of Qwl outcrop is mostly at a lower elevation than base of landward edge of Qwc, indicating that the two outcrop belts may be of different ages; forms scarps on landward side; fluviatile; thickness $100 \pm$ feet. (Williana Formation is a more recent name for deposits in Louisiana equivalent to the Willis Formation in Texas)

Appendix D - Boring Log(s)



CLIENT Cobb, Fendley & Associates PROJECT NAME Water Supply and Storage Facility No. 3
 PROJECT NUMBER 09-0065 PROJECT LOCATION FM 2920 & Tomball Cemetery Rd., Tomball, TX
 DATE STARTED 12/1/08 COMPLETED 12/1/08 GROUND ELEVATION _____ HOLE SIZE _____
 DRILLING CONTRACTOR Van and Sons GROUND WATER LEVELS:
 DRILLING METHOD Auger 0-15 feet AT TIME OF DRILLING ---
 LOGGED BY _____ CHECKED BY DJP AT END OF DRILLING ---
 NOTES Perched water encountered at 5-feet AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Unconfined Compression (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
											LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		Very loose to Loose, brown, fine grained, Poorly Graded Silty SAND (SM)	X SS		2-2-3 (5)					10				
		Soft, wet, gray, Low Plastic Sandy SILT (ML)	X SS		2-2-1 (3)					17	15	13	2	
		Petroleum hydrocarbon odors from 4 - 6 feet	X SS		2-1-1 (2)					19				
		Stiff, moist, light gray, Low Plastic Sandy CLAY (CL) with iron stains	ST			4.25	1.5			14				
10		Stiff, moist, light gray, Low Plastic Sandy CLAY (CL) / Clayey SAND (SC)	X SS		4-5-5 (10)					15				
			X SS		6-7-7 (14)					17				
		Bottom of hole at 15.0 feet.												

REV. GEO LOG W TOR & UC 08-0969 WATER SUPPLY.GPJ GINT US 29 JAN 07.GDT 2/11/09



CLIENT Cobb, Fendley & Associates

PROJECT NAME Water Supply and Storage Facility No. 3

PROJECT NUMBER 09-0065

PROJECT LOCATION FM 2920 & Tomball Cemetery Rd., Tomball, TX

DATE STARTED 12/1/08 COMPLETED 12/1/08

GROUND ELEVATION _____ HOLE SIZE _____

DRILLING CONTRACTOR Van and Sons

GROUND WATER LEVELS:

DRILLING METHOD Auger 0-15 feet

AT TIME OF DRILLING Groundwater not encountered.

LOGGED BY _____ CHECKED BY DJP

AT END OF DRILLING ---

NOTES _____

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Unconfined Compression (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
											LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		Very loose, brown, fine grained, Poorly Graded Silty SAND (SM)	SS		2-2-2 (4)					11				
		Soft, wet, gray, Low Plastic Sandy CLAY (CL) / Clayey SAND (SC) with iron stains	ST			0.5	0.2			18	26	15	12	
			ST			0.75	0.2			14				
		Stiff, moist, light gray, Low Plastic Sandy CLAY (CL) with iron stains	ST			3.0	1.3	1.1	117	14				
10			ST			3.5	1.2			15				
			ST			4.0	1.7			14				
		Bottom of hole at 15.0 feet.												



CLIENT Cobb, Fendley & Associates

PROJECT NAME Water Supply and Storage Facility No. 3

PROJECT NUMBER 09-0065

PROJECT LOCATION FM 2920 & Tomball Cemetery Road, Tomball, TX

DATE STARTED 1/26/09 COMPLETED 1/26/09

GROUND ELEVATION _____ HOLE SIZE _____

DRILLING CONTRACTOR Van and Sons

GROUND WATER LEVELS:

DRILLING METHOD Auger to 26 feet, Rotary Wash 26 to 50 feet

AT TIME OF DRILLING Groundwater not encountered.

LOGGED BY Jesus CHECKED BY DJP

AT END OF DRILLING ---

NOTES Boring caved at 26-feet.

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Unconfined Compression (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)	
											LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
0		Loose to medium dense, gray, fine grained, Poorly Graded Silty SAND (SM) Becomes wet and light gray with iron stains	AU							10					
			ST			0.25	0.1				12			NP	
			ST			0.25	0.1				15				
			ST			0.25	0.1				13				
10		Stiff, moist, light gray mottled red, Low Plastic CLAY with Sand (CL) and iron stains	ST			1.25	0.5	1.8	115	17	30	14	16		
			ST			3.25	1.3				14				
			ST			4.50	1.3	1.3	118	14	26	15	11		
20		Medium dense to dense, light gray, fine grained, Poorly Graded Silty SAND (SM)	SS		8-14-15 (29)					20					
			SS			15-21-23 (44)					17				
30		Very stiff, moist, light gray mottled red, High Plastic CLAY (CH)	ST			4.50	2.0	3.0	107	21	56	18	39		
			ST			4.25	2.0				22				
			ST			3.25	1.4				30				
			ST			4.25	0.9	2.5	99	24	61	22	39		
			ST												

REV. GEO. LOG W/TOR & UC 09-0065 WATER SUPPLY NO 3 ADDITIONAL BORING.GPJ GINT US 29 JAN 07.GDT 2/11/09

Bottom of hole at 50.0 feet.

Appendix E - Unified Soil Classification System

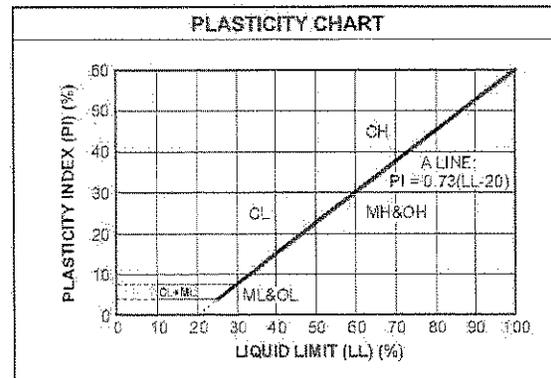


UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
Clean Gravels (Less than 5% fines)		
GRAVELS More than 50% of coarse fraction larger than No. 4-sieve size	GW Well-graded gravels; gravel-sand mixtures, little or no fines	
	GP Poorly-graded gravels, gravel-sand mixtures, little or no fines	
	Gravels with fines (More than 12% fines)	
	GM Silty gravels, gravel-sand-silt mixtures	
	GC Clayey gravels, gravel-sand-clay mixtures	
Clean Sands (Less than 5% fines)		
SANDS 50% or more of coarse fraction smaller than No. 4-sieve size	SW Well-graded sands, gravelly sands, little or no fines	
	SP Poorly graded sands, gravelly sands, little or no fines	
	Sands with fines (More than 12% fines)	
	SM Silty sands, sand-silt mixtures	
	SC Clayey sands, sand-clay mixtures	
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity	
	CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	OL Organic silts and organic silty clays of low plasticity	
SILTS AND CLAYS Liquid limit 50% or greater	MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
	CH Inorganic clays of high plasticity, fat clays	
	OH Organic clays of medium to high plasticity, organic silts	
HIGHLY ORGANIC SOILS	PT Peat and other highly organic soils	

LABORATORY CLASSIFICATION CRITERIA	
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3
GP	Not meeting all gradation requirements for GW
GM	Atterberg limits below "A" line or P.I. less than 4
GC	Atterberg limits above "A" line with P.I. greater than 7
Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3
SP	Not meeting all gradation requirements for GW
SM	Atterberg limits below "A" line or P.I. less than 4
SC	Atterberg limits above "A" line with P.I. greater than 7
Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:
 Less than 5 percent: GW, GP, SW, SP
 More than 12 percent: GM, GC, SM, SC
 5 to 12 percent: Borderline cases requiring dual symbols



TERMS DESCRIBING SOIL CONSISTENCY				
Fine Grained Soils		Coarse Grained Soils		
Description	Penetrometer Reading (tsf)	Penetration Resistance (blows/ft)	Description	Relative Density
Soft	0.0 to 1.0	0 to 4	Very Loose	0 to 20%
Firm	1.0 to 1.5	4 to 10	Loose	20 to 40%
Stiff	1.5 to 3.0	10 to 30	Medium Dense	40 to 70%
Very Stiff	3.0 to 4.5	30 to 50	Dense	70 to 90%
Hard	4.5+	Over 50	Very Dense	90 to 100%

Appendix F - Field Operations and Laboratory Testing

Field Operations

Subsurface conditions were defined using the sample boring(s) located as shown on the Boring Location Diagram (Appendix A). The boring(s) were advanced between sample intervals using continuous flight auger drilling procedures. The results of each boring are shown graphically on the Boring Logs (Appendix B). Sample depth, description, and soil classification based on the Unified Soil Classification System (Appendix C) are shown on the Boring Logs.

For cohesive soils, relatively undisturbed samples were obtained with Shelby tube samplers in general accordance with ASTM D1587 at the locations shown on the Boring Logs. The Shelby tube sampler consists of a thin-walled steel tube with a sharp cutting edge connected to a head equipped with a ball valve threaded for rod connection. The tube is pushed into the undisturbed soils by the hydraulic pulldown of the drilling rig. The soil specimens were extruded from the tube in the field, logged, tested for consistency using a hand penetrometer, sealed, and packaged to maintain "in situ" moisture content.

The consistency of cohesive soil samples was evaluated in the field using a calibrated hand penetrometer. In this test a 0.25 inch diameter piston is pushed into the undisturbed sample at a constant rate to a depth of 0.25 inch. The results of these tests are tabulated at respective sample depths on the logs. When the capacity of the penetrometer is exceeded, the value is tabulated as 4.5+.

Samples of granular and cohesive materials were obtained using split-barrel sampling procedures in general accordance with ASTM D1586. In the split-barrel procedure, a disturbed sample is obtained in a standard 2 inch OD split barrel sampling spoon driven into 18 inches into the ground using a 140-pound hammer falling freely 30 inches. The number of blows for the last 12 inches of a standard 18-inch penetration is recorded as the Standard Penetration Test resistance (N-value). The N-values are recorded on the boring logs at the depth of sampling. The samples were sealed and returned to our laboratory for further examination and testing.

Groundwater observations are shown on the boring logs. Upon completion of the boring, the boreholes were backfilled from the top and plugged at the surface.

Laboratory Testing

LFC, Inc. performs visual classification and any of a number of laboratory tests, as appropriate, to define pertinent engineering characteristics of the soils encountered. Tests are performed in general accordance with American Society for Testing and Materials (ASTM) procedures and results are included at the respective sample depths on the boring logs. Laboratory tests and procedures routinely utilized, as appropriate, for geotechnical investigations include:

- ASTM D421 – Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
- ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D1140 – Standard Test Methods for Amount of Material in Soils Finer than the No. 200 (75- μ m) Sieve
- ASTM D2166 – Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D2217 – Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
- ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D2850 – Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soil
- ASTM D4220 – Standard Practices for Preserving and Transporting Soil Samples
- ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D4643 – Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- Soil Strength Determination Using a Torvane